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# **USSR Report**

**PHYSICS AND MATHEMATICS**

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USSR REPORT  
PHYSICS AND MATHEMATICS

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(A.E. Bashirov, R.R. Gadzhiev; IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIH I MATEMATICHESKIH NAUK, No 2, Apr-Jun 84)..... 81

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(A.S. Rasulov; PRIKLADNAYA MATEMATIKA I MEKHANIKA: SBORNIK NAUCHNYKH TRUDOV, 1983)..... 85

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(A.V. Vyedorov, V.M. Fomin, et al.; DOKLADY AKADEMII NAUK SSSR, No 1, Mar 85)..... 86

ACOUSTICS

UDC: 532.501.34

AMPLIFICATION OF ACOUSTIC PERTURBATIONS DURING REFLECTION FROM CRITICAL LAYER IN SUPERSONIC FLOWS

Moscow DOKLADY AKADEMII NAUK SSSR Vol 280, No 1, Jan 85 in Russian (manuscript received 30 Mar 84) pp 95-98

KOLYKHALOV, P.I., Institute of Space Research, USSR Academy of Sciences.

[Abstract] The propagation of acoustic perturbations in a medium moving at a variable velocity is investigated. A planar flow of an ideal gas moving parallel to the Y axis at a rate that varies along the X axis is examined. The amplitude of the perturbations is found to increase upon reflection from the critical layer (the layer in which the velocity of the stream is the same as the phase velocity of the perturbations), if the change in the velocity of the stream exceeds the speed of sound on scales of the order of the wavelength of the perturbation. It is suggested that instability of the acoustic resonance type occurs in supersonic flows near a hard barrier. References 9: 7 Russian, 2 Western.

[227-6900]

UDC: 536.24:532.135

DISPERSION OF SOUND IN RELAXING POLYMER LIQUID CONTAINING BUBBLES

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 1, Jan 85 (manuscript received 21 Oct 83) pp 63-69

SHUL'MAN, Z.P. and LEVITSKIY, S.P., Institute of Heat- and Mass-Exchange imeni A.V. Lykov, Belorussian SSR Academy of Sciences, Voronezh State University imeni Lenin Komsomol.

[Abstract] A dispersion equation is derived for a relaxing polymer liquid with gas inclusions that accounts for all basic dissipative effects accompanying pulsation of bubbles in a wave. The propagation of sound in a medium containing bubbles is viewed as a process of repeated scattering of a fundamental signal. It is found that an increase in the amplitude of pulsations of gas

bubbles in a wave caused by viscoelastic effects results in a significant increase in the absorption of sound in a liquid containing bubbles near their resonant frequencies. The attenuation of sound in a relaxing medium containing bubbles at a distance from the resonant frequency can be significantly less than in an analogous viscous liquid. The role of the rheological factor becomes smaller as the concentration of the inclusions and the dimensions of the bubbles increase. The findings are explained physically by a change in the contribution of the rheological dissipative mechanism to the overall dissipation during propagation of sound in a rheologically complex relaxing medium containing bubbles. The dispersion and absorption of sound in the resonant zone do not increase because the dissipative losses during pulsations of the bubbles are significantly lower than in an analogous viscous liquid. References 11: 10 Russian, 1 Western.  
[251-6900]

## CRYSTALS, LASER GLASSES AND SEMICONDUCTORS

UDC: 621.315.592

### RESISTANCE OF YAG:Nd<sup>3+</sup> LASER FREQUENCY CONVERTERS TO IONIZING RADIATION

Moscow AKADEMIYA NAUK SSSR INSTITUT OBSHCHEY FIZIKI. Preprints in Russian No 58, (signed to press 3 Jan 84)

ZAKHARKIN, B.I., KULEVSKIY, L.A., NIKOLAYEV, V.N. and TOROPKIN, G.N., Institute of General Physics, USSR Academy of Sciences.

[Abstract] This study presents a review of published work on the radiation resistance of YAG:Nd<sup>3+</sup> laser frequency converters, and describes the results of experiments on the influence of gamma-irradiation of nonlinear crystals on the output characteristics of YAG:Nd<sup>3+</sup> lasers with second-harmonic generation inside or outside the cavity. The influence of radiation on the optical properties of nonlinear crystals is investigated. It is found that radiation degrades the generation of optical harmonics in YAG:Nd<sup>3+</sup> lasers employing nonlinear elements made of SDA, DSDA, LiIO<sub>3</sub>, and DKDR crystals, starting at doses of 10<sup>5</sup> - 10<sup>6</sup> rad. Deuterized nonlinear crystals are found to be more resistant to ionizing radiation. References 24: 18 Russian, 6 Western.  
[332-6900]

UDC 530.145

### POSSIBILITY OF CHANNELING OF $\gamma$ -QUANTA AND NEUTRONS

Moscow DOKLADY AKADEMII NAUK SSSR, Vol 281, No 1, (manuscript received 3 July 84) pp 67-70

ZHYEVAGO, N.K., Institute of Atomic Energy imeni I.V. Kurchatov

[Abstract] The conditions necessary to support channeling of  $\gamma$ -quanta in crystals are analyzed. Simple estimates show that  $\gamma$ -quantum channeling does not occur in ordinary crystals because quanta incident at a small angle to the planes of the crystal do not respond to local changes in the electron density, so that the crystal acts like a solid medium with a certain electron density. In order for channeling to occur, the electron density must be modulated with a period significantly exceeding the amount  $\lambda_1 = c/\omega_p \sim 10\text{\AA}$ . This condition can

be realized in crystals containing a superlattice of holes, which are formed under certain conditions by irradiating crystals with neutrons or ions. The electromagnetic wave incidence conditions under which quantum channeling is possible are analyzed. Neutron channeling is also shown to be possible in a superlattice of holes. It is pointed out that lattices of holes are not the only three-dimensional structures that exhibit an electron density modulation period that supports channeling, e.g., certain types of opals consist of tightly packed  $\text{SiO}_2$  spheres that form a suitable superlattice. References 7: 2 Russian, 5 Western.  
[331-6900]

#### RAMAN SCATTERING OF LIGHT IN GALLIUM-ARSENIDE CRYSTALS EXPOSED TO SUBNANOSECOND LASER PULSES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 19, No 2, Feb 85  
(manuscript received 13 Mar 84) pp 252-256

RESHINA, I.I., SMOL'SKIY, O.V. and VASIL'YEV, A.N., Physical-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences.

[Abstract] Raman scattering and reflection in the visible region of the spectrum are used to investigate single-crystal laser-amorphized gallium-arsenide. The thickness of the amorphous layer and the quality of the recrystallized material are determined as a function of the crystallographic orientation of the target and the laser energy. The specimens were irradiated by a single second-harmonic pulse from a  $\text{YAG:Nd}^{3+}$  laser ( $\lambda = 532 \text{ nm}$ ). The irradiation produced a spot 1 - 2 nm in diameter on the surface of the specimen within which from 1 to 3 annular regions with slightly different brightness could be observed. The light peripheral ring was found to characterize the region of the amorphous phase, which has a slightly larger reflection coefficient than the crystalline phase. The combined measurements of reflection and Raman scattering spectra made it possible to identify the regions of morphous and crystalline phases in GaAs crystals with different orientation. It is hypothesized that an amorphous layer exists beneath the recrystallized layer. References 9: 2 Russian, 7 Western.  
[342-6900]

LACK OF CORRESPONDENCE OF LATTICE PERIODS AND INTENSITY OF PHOTOLUMINESCENCE  
IN GaInSbAs/GaSb HETEROCOMPOSITIONS

Leningrad PIS'MA ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4,  
26 Feb 85 (manuscript received 18 Sep 84) pp 193-196

BERT, N.A., VASIL'YEV, V.I., KONNIKOV, S.G., KUCHINSKIY, V.I., LAZUTKA, A.S.,  
MISHURNYY, V.A. and PORTNOY, Ye.L., Physical-Technical Institute imeni  
A.F. Ioffe, USSR Academy of Sciences.

[Abstract] The influence of lattice discrepancy of luminescence efficiency in  
 $Ga_{1-x} In_x Sb_{1-y} As_y /Ga^b$  heterocompositions is investigated. Photoluminescence  
was investigated by using a specimen with a heteroepitaxial layer  $1.5 \mu m$   
thick that passed only a small amount of the driving radiation to the substrate.  
It is found that the absence of dislocations is not enough to obtain efficient  
luminescence in compositions with a comparatively wide range of pseudomorphic  
growth, which significantly narrows the possibility of reducing the level of  
residual elastic stresses in heterocompositions intended for use in radiating  
devices. References 7: 4 Russian, 3 Western.

[247-6900]

LASING IN VISIBLE REGION OF SPECTRUM BY  $Al_2O_3$  COLOR CENTERS AT ROOM TEMPERATURE

Leningrad PIS'MA ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4,  
26 Feb 85 (manuscript received 14 Jun 84) pp 200-202

MARTYNOVICH, Ye.F., BARYSHNIKOV, V.I. and GRIGOROV, V.A., Scientific  
Research Institute of Applied Physics, Irkutsk State University imeni  
A.A. Zhdanov.

[Abstract] Color centers are investigated that exhibit optical absorption  
and luminescence bands with respective maxima of  $0.46$  and  $0.55 \mu m$ . Optical  
stability was assessed by comparing the operation of the experimental laser  
element with that of an  $LiF-F_2$  element. Color centers are detected in  
corundum single crystals that are capable of generating lasing in the visible  
region of the spectrum. Color center lasing is achieved in the  $0.55-0.62 \mu m$   
region. References 2 Russian.

[247-6900]

UDC: 535.33/.34:548.0

BLEACHING EFFECT IN ALKALI-HALIDE CRYSTALS WITH ELECTRON COLOR CENTERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 13 Jun 83) pp 1026-1028

MEDVEDEV, B.A., SILKINA, T.G. and SIMONENKO, G.V.

[Abstract] Laser media with two types of color centers connected by radiative and non-radiative energy transfers are investigated. Alkali-halide crystals containing two types of color centers with overlapping absorption and luminescence bands (as represented by  $F_2^+$ ,  $F_2^-$ ;  $F_2$ ,  $F_2^+$  center pairs) in a LiF crystal are examined. The real center is approximated by four energy levels, including the laser pumping exciting centers (I), and the luminescence of centers (I) and pumping centers (II). Balance equations and Maxwell equations describing the processes occurring in this system are derived. The contour of the absorption (amplification) line in a bleaching channel is investigated. The findings expand the capabilities of nonlinear high-resolution spectroscopy of multicomponent systems, and make it possible to optimize the parameters of existing binary dye lasers and color center lasers. References 7: 5 Russian, 2 Western.

[236-6900]

UDC: 539.22:535.32

SIMPLE METHOD FOR DETERMINING INDICES OF REFRACTION OF OPTICALLY ANISOTROPIC MEDIA

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, Jul 84 (manuscript received 28 Jun 83) pp 3-5

CHISTYY, I.L. and GOROKHOVA, L.N.

[Abstract] Analytical formulas are derived which relate the angles of extinction with the main indices of refraction of optically anisotropic media. A method is presented for finding the complete set of diagonal elements of the permittivity tensor of the crystal and their associated main refraction indices. The extinction angles are investigated experimentally in calcite and triglycerine sulfate crystals. The close agreement with published extinction angle data indicates that the proposed method is entirely suitable for finding the indices of refraction of optically anisotropic media. References 11: 9 Russian, 2 Western.

[135-6900]

UDC: 666.266

TWO-LEVEL KINETIC SCHEME FOR DARKENING PHOTOCHROMIC GLASS EXPOSED TO  
PERIODIC PULSES

Leningrad FIZIKA I KHIMIYA STEKLA in Russian Vol 10, No 6, Nov-Dec 84  
(manuscript received 2 Mar 84) pp 718-721

DOTSENKO, A.V.

[Abstract] A mathematical model is derived to describe the behavior of photochromic glass irradiated by a succession of light pulses. A simple 'two-level' kinetic scheme is used to describe the trends of the behavior of photochromic glasses. The pulse length is assumed to be sufficient for the quantity  $\tau$  to be significantly greater than the characteristic formation time of an individual color center. The kinetics of the darkening of photochromic glass is compared for radiation with different intensity.

References 6: 5 Russian, 1 Western.

[245-6900]

## GAS DYNAMICS

UDC: 621.375.826

### EFFICIENCY OF COMPRESSED GAS ENERGY CONVERSION TO LASER RADIATION

Moscow TEPLOFIZIKA VYSOKIKh TEMPERATUR in Russian Vol 22, No 6, Nov-Dec 84  
(manuscript received 28 Apr 83) pp 1196-1199

BREYEV, V.V. and PANCHENKO, V.P.

[Abstract] This study investigates the use of a series of reservoirs in which gas is heated by passing from one reservoir to the next as an auxiliary heat source for a gas dynamic laser. The characteristics and efficiency of such a laser system are assessed. It is found that the coefficient of conversion of compressed gas energy to laser radiation can be as high as approximately  $10^{-2}$  % for a helium mixture, and approximately half that for an air mixture ( $\text{CO}_2 + \text{N}_2 + \text{O}_2 + \text{H}_2\text{O}$ ), because of the low energy transmission factor in the system of reservoirs. The findings, while not optimum, provide a clear idea of the characteristic efficiency value of the system and its components. References 4 Russian.

[207-6900]

### RELAXATION OF BEAM INSTABILITY

Moscow AKADEMIYA NAUK SSSR, INSTITUT OБSHCHEY FIZIKI, LABORATORIYA FIZIKI PLAZMY, Preprint No 172 in Russian, 1984 (signed to press 12 Jun 84)

KUZELEV, M.B., PANIN, V.A., RUKHADSE, A.A. and FILIPPYCHEV, D.S., Institute of General Physics, USSR Academy of Sciences.

[Abstract] A general nonlinear theory of beam instabilities is developed that makes possible a unified description of the multiplicity of complex nonlinear phenomena occurring in electron beams. Four mechanisms underlying beam instability saturation are presented and investigated numerically. The nonlinear dynamics of beam instabilities are modeled quasikinetically. Buneman resonant instability is examined. Resonant decay in a system with a solid beam and periodic beam instability in plasma are investigated analytically. References 37: 36 Russian, 1 Western.

[310-6900]

SHOCKWAVE PROPAGATION IN TRANSVERSE GLOW DISCHARGE PLASMA IN ARGON

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4,  
26 Feb 85 (manuscript received 12 Dec 84) pp 209-214

BASARGIN, I.V. and MISHIN, G.I., Physical-Technical Institute imeni  
A.F. Ioffe, USSR Academy of Sciences.

[Abstract] Shockwave propagation in a glow discharge plasma perpendicular to the axis is investigated in a working mixture consisting of argon at 34 mm Hg, with temperature of 293 K in the absence of plasma. The experimental setup consists of a cylindrical chamber and an electromagnetic shock tube in which a glow discharge is created between water-cooled conical copper electrodes. Shockwave propagation in the plasma was investigated by recording the elapsed time between the generation of the shockwave and the moment of arrival of the shockwave at a given point in the plasma. It is found that the ion-sound waves that occur ahead of the shockwave front during the dissipation process increase the velocity of the neutral particles, increasing the propagation velocity of the shockwave in the plasma. Because of this, the propagation velocity is greater than that governed by the thermal speed of sound, and less than that of ion-sound waves. References 7 Russian.

[247-6900]

UDC: 533.6.011:536.14

COOLING OF STREAM OF GAS CONSISTING OF DIATOMIC MOLECULES BY RESONANT RADIATION

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 5, Sep-Oct 84 pp 8-16

STARIK, A.M.

[Abstract] The characteristics of the flow of a mixture containing a gas comprised of diatomic dipole molecules in a resonant radiation field are investigated. Changes in the macroscopic and microscopic parameters of the flow are analyzed. The findings are illustrated using the example of the flow of hydrogen chloride and an HCl-H<sub>2</sub> mixture. It is found that variation in the macroscopic parameters of the flow occurring during the absorption of resonant radiation by gas can be the determining factor in investigating unsteady self-focusing of laser beams. References 7 Russian.

[184-6900]

UDC: 536.71:532.529

ATTENUATION OF STRONG SHOCK WAVES IN TWO-PHASE AND HETEROGENEOUS MEDIA

Novosibirsk ZHURNAL PRIKLAKNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 5, Sep-Oct 84 (manuscript received 6 Jul 83) pp 24-29

AL'TSHULER, L.V. and KRUGLIKOV, B.S.

[Abstract] A formula describing the attenuation of shock waves is derived and used to examine attenuation in an ideal gas, a porous incompressible Kompanejets medium and an equilibrium two-phase mixture. The formation of internal superheated regions reduces the damping properties of porous incompressible and two-phase media. The presence of an incompressible framework in the propagation zone that stretches the shock wave front and transforms the unidimensional gas flow to a system of jets that are retarded upon striking the elements of the framework is analyzed. It is found that the mechanical energy produced by an explosion is fully absorbed by introducing an evaporating component in the form of droplets, foam or aerosol with high particle evaporation heat into the framework system. References 16: 14 Russian, 2 Western.

[184-6900]

UDC 533.6.011

THERMAL FEATURES OF SUPERSONIC GAS FLOW

Leningrad ZHURNAL TEKHNICHESKIY FIZIKI in Russian, Vol 55, No 1, Jan 85  
(manuscript received 25 Apr 84) pp 230-232

SKVORTSOV, G. Ye. and VASIL'YEV, N. Yu., Leningrad State University imeni A.A. Zhdanov

[Abstract] The features of a steady-state gas flow with thermal factor governed by the physical-chemical conversions or the direct action of heat on the stream are investigated. Flow instability is detected for a certain cooling level, and an interpretation of recent experiments on shockwave propagation in a glow discharge plasma is presented. An anomaly noted during cooling, which corresponds to possible shockwave instability, is discussed. Figures 0, references: 6 Russian.  
[261-6900]

UDC 533.951

HYPersonic PROPERTIES OF REGULAR COUNTER-INTERACTION OF TWO SHOCKWAVES

Leningrad ZHURNAL TEKHNICHESKII FIZIKI in Russian Vol 55, No 1, Jan 85  
(manuscript received 21 Feb 84) pp 148-152

TIKHOMIROV, N.A.

[Abstract] The problem of regular counter-interaction of two shockwaves intersecting at a slight angle is examined within the framework of a hypersonic approximation, which reduces the number of determining parameters and yields simpler relationships for determining the flow field behind the refractive shockwaves. It is shown that for the interaction of two strong shocks the solution depends only upon the parameter that characterizes the ratio of their intensities. The approach can also be used to examine other types of regular interactions, such as the interaction of a shockwave with the interface between two gaseous media having different densities, tangential separation, and regular interaction between two shockwaves. Figures 3, references: 5 Russian.

[261-6900]

FLUID DYNAMICS

UDC: 532.517.4

INTERACTION OF GENERATORS WITH EXCITATION AND THE PROBLEM OF TURBULENCE

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 4 July 83) pp 22-25

LANDA, P.S. and PERMINOV, S.M., Moscow State University imeni M.V. Lomonosov

[Abstract] A model for the occurrence of turbulence is proposed that interprets complex quasiperiodic movement with a nearly solid spectrum after several bifurcations. The occurrence of hard excitation is posited, i.e., there exists a wide range of Reynolds numbers for which the laminar flow is stable with respect to small perturbations and unstable with respect to perturbations of finite amplitude. The set of potential excited modes is compared to a set of coupled generators with hard excitation; self-excitation conditions are satisfied for some, and not for others. It is demonstrated that asynchronous excitation of the unexcited generators is possible in such a system, similar to the asynchronous excitation of a single generator with hard excitation subjected to external force at other than the resonant frequency. The model also makes it possible to interpret the occurrence of turbulence without satisfying self-excitation conditions for any single mode.

References 15: 8 Russian, 7 Western.

[187-6900]

UDC: 532.526, 532.517.4

ANALYSIS OF MODELS OF TURBULENCE DESCRIBING FLOWS WITH CURVILINEAR CURRENT LINES

Piga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA FIZICHESKIKH I TEKHNICHEISKIKH NAUK in Russian No 1, Jan-Feb 85 (manuscript received 27 Jun 84) pp 97-105

SUKHOVICH, Ye.P. and USHKANS, A.L., Institute of Physics, Latvian SSR Academy of Sciences.

[Abstract] This study analyzes the accuracy of existing methods for describing the influence of curvature of current lines on the flow in the

boundary layer along a curved surface. The calculation employ four modifications of the algebraic turbulence model. The analytical results are compared with experimental findings, and recommendations are given on the selection of a turbulence model that is suitable for describing the effects observed experimentally. The model based on the best description of the experimental data for the pressure--deformation correlation in a flow with a homogeneous shift--describes a flow with curved current lines most accurately. This model describes well the anisotropy of velocity pulsations and the distribution of friction stresses in the boundary layers on curvilinear surfaces. References 20: 10 Russian, 10 Western.  
[248-6900]

UDC: 532.529:534.2.532

#### PROPAGATION OF SMALL PERTURBATIONS IN VAPOR-LIQUID POROUS MEDIA

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 5, Sep-Oct 84 (manuscript received 12 Jul 83) pp 34-43

VAKHITOVA, N.K. and SHAGAPOV, V.Sh.

[Abstract] The propagation of small sunusoidal waves in a liquid containing bubbles of vapor is examined. The region of values of the parameters of the two-phase medium as well as the perturbation frequency, for which the perturbation propagation velocity is described by Landau's formula, is identified by analyzing the dispersion formula. Effects associated with phase transitions and capillary phenomena are found to result in fundamentally new behavioral characteristics: in contrast to porous gas-liquid media, vapor-liquid media may be unstable. The tendency toward instability increases as the mixtures become more finely dispersed and as the volumetric content of bubbles decreases. Very finely dispersed porous vapor-liquid mixtures are therefore highly unstable, and consequently difficult to confine. References 7 Russian.

[184-6900]

UDC: 532.13:539.89

#### MEASUREMENT OF VISCOSITY OF SHOCK-COMPRESSED WATER

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 5, Sep-Oct 84 (manuscript received 17 Jul 83) pp 44-48

KIM, G.SH.

[Abstract] The dynamic coefficient of viscosity of water shock-compressed to 6-7.5 GPa at initial temperatures of 15-18°C is measured by recording the velocity of a thin metal cylinder placed in a layer of water compressed

by a shock wave. The analysis makes allowance for the Bass and resistive forces. It is found that the determination of the dynamic coefficient of viscosity depends strongly upon the time required to achieve quasisteady-state flow, as well as the amount of time the flow exhibits constant parameters in the vicinity of the cylinder. References 16: 14 Russian, 2 Western. [184-6900]

UDC: 532.595.2

#### CLEAVING OF LIQUID METAL SUBJECTED TO PULSE RADIATION

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian No 5, Sep-Oct 84 (manuscript received 17 Jul 83) pp 55-59

KOLGATIN, S.N., STEPANOV, A.M. and KHACHATUR'YANTS, A.V.

[Abstract] The negative pressures and fractures occurring at the free surface of liquid metal subjected to compression waves are investigated in gas dynamic approximation. The influence of the pulse energy and duration and the distance traveled by the radiation in the material on the amount of tensile stresses and fracturing in liquid is investigated numerically. It is found that liquid fractures within the layer are practically unavoidable when the liquid metal layer is exposed to powerful pulse radiation.

References 10: 9 Russian, 1 Western.

[184-6900]

UDC: 517.948.35

#### A GROUP OF OPERATORS OCCURRING IN THE DYNAMICS OF A COMPRESSIBLE STRATIFIED FLUID

Moscow DOKLADY AKADEMII NAUK SSSR Vol 280, No 1, Jan 85 in Russian (manuscript received 9 Feb 84) pp 23-26

GABOV, S.A. and MAMEDOV, K.S., Moscow State University imeni M.V. Lomonosov, Institute of Mathematics and Mechanics, Azerbaijan SSR Academy of Sciences.

[Abstract] Small movements of a compressible stratified fluid are investigated in a Cartesian system of coordinates ( $x_1, x_2, x_3$ ). The fluid is assumed to be exponentially stratified along the  $x_3$  axis, i.e., its density in the unperturbed state is assumed to be a function of  $x_3$  alone. Boundary conditions are derived for the equation describing small movements of this fluid in a gravitational field. An eigenvalue problem (a problem of normal oscillations) is derived that reduces in an equivalent fashion to a group of operators in which the operator  $S$  is only bounded, and not entirely continuous, as was assumed in previous studies. It is found that the condition of strong spectral decoupling is always satisfied in cases of practical interest involving the sound propagation velocity in water. References 12 Russian. [227-6900]

UDC: 532.583.4:629.125

NUMERICAL SOLUTION OF PLANAR PROBLEMS FROM SURFACE WAVE THEORY

Irkutsk METODY VOZMUSHCHENIY V MEKHANIKE SBORNIK NAUCHNYKH TRUDOV in  
Russian, 1984 (signed to press 17 Dec 84) pp 64-73

AKIMOV, A.N.

[Abstract] A numerical solution is presented to the planar problem of motion of a body beneath the free surface of a liquid considering the formation of eddies. The problem is reduced to an integral equation of the second kind which is solved by the spline colocation method. The algorithm suggested allows computation with arbitrary Froude number for bodies of arbitrary shape immersed at slight depth or with slight thickness. The experiment demonstrates that the error in the results does not become significantly worse as the body approaches the free surface. There is no loss of accuracy of the results for thin wings. The program developed allows solution of problems of practical importance of wings of arbitrary shape. Accuracy can be improved by the use of the potential asymptote near the corner points or by the use of rapid convergence. Figures 3, references 7: 5 Russian, 2 Western.

[047-6508]

HIGH-TEMPERATURE PHYSICS

UDC: 621.378.3

KINETICS OF VIBRATIONAL RELAXATION IN CO:N<sub>2</sub>:H<sub>2</sub>O MIXTURE DURING FREE SCATTERING

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 6, Nov-Dec 84  
(manuscript received 5 Sep 83) pp 1055-1060

KOVSH, I.V., PYATAKHIN, M.B. and URIN, B.M., Physics Institute imeni  
P.N. Lebedev, USSR Academy of Sciences.

[Abstract] This study investigates the possibility of obtaining inverse population on vibration-rotation transitions of a CO molecule during free scattering of a CO:N<sub>2</sub>:H<sub>2</sub>O gas mixture due to different relaxation rates of the reciprocating and vibrational temperatures of the molecules. Gas dynamic equations and equations describing the population of the vibration levels of the molecules are solved jointly. The vibration temperatures of CO and N<sub>2</sub> are found to be frozen at a level slightly greater than 1000 K for an initial density of 1.5 g/cm<sup>3</sup> and 33% water content; the total amount of energy stored in the vibrational degrees can be as high as 50 J/g. The use of cylindrical scattering geometry instead of spherical does not change the findings quantitatively. References 12: 7 Russian, 5 Western.  
[207-6900]

UDC 532.526+534.222.2

COMBUSTION IN TURBULENT BOUNDARY LAYER FOLLOWING SHOCK WAVE

Moscow VESTNIK MOSKOVOSKOGO UNIVERSITETA SERIYA 1: MATEMATIKA, MEKHANIKA in Russian No 2, Mar-Apr 85 (manuscript received 14 Apr 83) pp 52-55

ZVYERYEV, I.N., RAMODANOV, M.I. and RAMODANOVA, T.V.

[Abstract] The temperature in the chemically reacting turbulent boundary layer following a shock wave is calculated in the presence of evaporation of fuel from the walls and combustion of the vapors within the boundary layer. A two-layer turbulent layer is assumed in which the Prandtl and Schmidt numbers, as well as their turbulent analogs, are equal to unity. The coefficient of diffusion of the multicomponent mixture is replaced with the coefficient of a binary mixture consisting of the initial reagents and the final

combustion products. It is found that practically no combustion develops in the laminar sublayer. The temperature profiles exhibit clearly defined extrema that correspond to the most intense combustion. The maximum temperature practically stops increasing in a nonself-similar boundary layer at a certain distance from the shock wave front that depends upon the shock wave velocity, indicating that the chemical reactions become less intense as the longitudinal coordinate  $x$  increases. References: 7 Russian.  
[353-6900]

UDC: 532.5.031-2

#### DETERMINING REMOVAL OF OUTBURST DURING EXPLOSION IN SOIL WITH ANGULAR AND CURVILINEAR FREE BOUNDARIES

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian, No 1, Jan-Feb 85 (manuscript received 25 Jan 84) pp 3-9

RODIONOV, A.T. and TERENT'YEV, A.G.

[Abstract] This study examines boundary-value problems in determining the removal of outburst when uniformly distributed point explosives are detonated on the surface of, and within, isotropic soil with angular and curvilinear free boundaries. M.A. Lavrent'yev's statement, in which the critical velocity  $V_o = \text{const}$ , is employed. The colocation solution method is compared with the iterative method, and found to be ten times faster. References 6 Russian.  
[344-6900]

UDC: 532.5.013.4:536.46

#### INVESTIGATION OF STABILITY OF STATIONARY FRONT OF EXOTHERMIC REACTION IN CONDENSED PHASE

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA ZHIDKOSTI I GAZA in Russian (manuscript received 22 Feb 84) pp 115-118

AVDEYEV, P.A.

[Abstract] A model system of combustion theory is examined that describes the exothermic reaction in the condensed phase. A piecewise-constant relationship between reaction rate and temperature is substituted for the Arrhenius relationship, making it possible to find the distribution of the quantities in the steady-state wave and to investigate the stability of the solution with respect to unidimensional perturbations. Reference 1 Russian.  
[344-6900]

INVESTIGATION OF SHEARED SILICON SURFACE BY MICROWAVE AND OPTICAL REFLECTION METHODS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian, Vol 19, No 2, Feb 85 (manuscript received 16 Jul 84) p 348

BELOKONOV, A.N., GALAYEV, A.A., MILYAYEV, V.A., NIKITIN, V.A., PARKHOMENKO, Yu.N. and SHIRKOV, A.V., Moscow Institute of Steel and Alloys.

[Abstract] The use of contactless microwave testing to determine the rate of surface recombination in an area excited by nonequilibrium carriers is used to determine the surface recombination rate as a function of the step density. The step density is measured by the optical reflection method, based on the deviation from the normal of the laser beam reflected from the sheared surface. In the microwave method, the kinetics of the drop in concentration of nonequilibrium carriers in the microwave field are investigated while a laser pulse is being applied. It is found that the recombination rate increases almost linearly as the step density, indicating that recombination through local energy levels is the main mechanism underlying surface recombination in a (111) fragment of silicon. References 3: 1 Russian, 2 Western. [342-6900]

LOCALIZATION AND THERMAL STABILITY OF DEFECTS CAUSED BY LASER RADIATION OF GERMANIUM

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian, Vol 19, No 2, Feb 85 (manuscript received 5 Jun 84) pp 234-236

KASHKAROV, P.K. and PETROV, A.V., Moscow State University imeni M.V. Lomonosov.

[Abstract] This study investigates the localization and thermal stability of charge carrier recombination and trapping centers occurring in the surface layer of germanium when high-resistance single crystals are irradiated by nanosecond pulses from a neodymium laser. The surface of (111) high-resistance single crystals of n-type germanium etched in  $H_2O_2$  at 310 K was examined. Irradiation was provided by a monopulse neodymium Q-switched laser. It is suggested that defect generation during laser irradiation below  $10 \text{ MW/cm}^2$  is associated with electron-vibrational excitation of the trapping centers and radiationless recombination of nonequilibrium charge carriers. This excitation may change the properties of existing defects, and also lead to the occurrence of new centers. It is found that different systems of centers are responsible for surface recombination and trapping of charge carriers. References 6: 3 Russian, 3 Western. [342-6900]

## EXTINCTION OF ELECTRON AVALANCHE AHEAD OF CONTACT PLASMA-AIR BOUNDARY

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4,  
26 Feb 85 (manuscript received 2 Oct 84) pp 218-220

FISHER, V.I., Odessa State University imeni I.I. Mechnikov.

[Abstract] The optical breakdown of air 1 - 2 cm from the plasma-air contact boundary observed during the interaction of giant laser pulses with a quasi-steady state plasma flame is analyzed. It is found that the 'pure' rise time of the electron avalanche in hot air is greater than in cold air, so that the breakdown of hot air is more difficult. If this is the case, and the location of the breakdown zone is actually governed by high air temperature, the position of the laser spark in the experiment marks the effective boundary of the heated layer in the air. References 5: 3 Russian, 2 Western.  
[247-6900]

UDC: 532.527:535.211

## EDDY FORMATION DURING LASER IRRADIATION OF POLYMERS

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 5, Sep-Oct 84 (manuscript received 28 Jun 83) pp 64-68

AVERSON, A.E., ALEKSEYEV, M.V. and BORISOV, V.P.

[Abstract] The hydrodynamics of the outflow of the destruction products of polymers subjected to laser radiation with flux density of less than  $10 \text{ kw/cm}^2$  is investigated. The targets employed were polymethylmethacrylate specimens in air at  $T = 293\text{K}$  and  $p = 10^5 \text{ Pa}$ . The flow of the destruction products was visualized by stroboscopic laser chopping. The effect of an igniting pulse on the polymer surface is found to result in the formation of eddy structuring in the gas flow. The parameters of eddy ring formation are plotted, and photographs of various stages of eddy formation are presented.  
References 11 Russian.  
[184-6900]

## POWER TRANSMISSION BY RELATIVISTIC ELECTRON BEAMS PROPOSED

NTR: PROBLEMY I RESHENIYA, 5 Feb 85 p 2

[Text] At present, our country's power industry is dealing with power levels of hundreds of millions of kilowatts. For the transmission of electric power in this case, it is necessary that at a tension of, let us say, one million volts in the power line, a current of thousands of amperes must flow through it. But the stronger the current, the more substantial are the losses of power in the line, and the larger the diameter of the conductor must be. In other words, the limit of the possibilities of overhead power lines has almost been reached. Alternative means of power transmission--gas-insulated lines, superconducting cables and others--are under intense study.

Doctor of Technical Sciences Ye. A. Abramyan, head of a department of the USSR Academy of Sciences' Institute of High Temperatures (IVTAN), spoke about the characteristics and prospects of one of the fundamentally new power transmission methods, namely, the transmission of electric power by streams of relativistic electrons (electrons moving at nearly the speed of light) which travel in an electron-conducting vacuum tube.

"The essence of the method is that electric power is transformed into the kinetic energy of a stream of accelerated electrons at the place where it is generated, while the opposite transformation is effected at the place where it is used--the regeneration of the beam's power.

"The main advantages of such a power line are the transmission of high power levels of the order of tens and hundreds of gigawatts, the absence of high voltages along the routes, and high efficiency. Practical problems involve the development of economical systems for confining the beam in the tract and of systems for creating and maintaining a vacuum in an electron tract many kilometers long.

"This is how it looks in more detail. The electric power generated by a power station goes at standard voltages and frequency to a substation which steps up the voltage. Under the influence of an applied voltage, a stream of electrons is emitted and accelerated in an accelerator. A narrow electron beam focused by a magnetic field is transmitted through a buried (2-2.5 meters underground) metal-coated or metal tube 0.5-1 meter in diameter.

"At IVTAN, a test stand for modeling a line for the transmission of electric power by means of an electron beam is being built. It will be a transmission line several dozen meters long and with a power level of up to 10 million kilowatts. Many questions must still be answered: how to better focus the beam in the tube, and what kinds of accelerators will ensure the necessary parameters of the electron beam."

(A drawing is given showing the arrangement of elements of the system for the transmission of electric power by means of an electron beam.)

FTD/SNAP  
/9716  
CSO: 1862

UDC: 536.422.1

THEORETICAL MODEL OF INTERACTION BETWEEN STRONG-CURRENT RELATIVISTIC ELECTRON BEAM AND METALLIC BARRIER

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 47, No 6, Dec 84  
(manuscript received 21 Jul 83) pp 952-957

ROMANOV, G.S., SUZDENKOV, M.V., TETEREV, A.V. and FOKOV, G.A., Scientific Research Institute for Applied Physical Problems, Belorussian State University imeni V.I. Lenin.

[Abstract] A hydrodynamic model is employed to describe the dynamics of the phenomena occurring during target breakdown by relativistic electron beams with current of  $10^6 - 10^7$  A, and electron energy of 1 - 10 MeV. The model accounts for dissipative processes associated with the transfer of beam energy to the matter comprising the target, deformation and breakdown of the target by the shock wave, and the transfer of energy to highly heated target vapors by radiation diffusion. The movement that occurs is assumed to be axisymmetrical. Experiments in which an aluminum plate 1 cm thick was exposed to pulses with electron energy of 1 MeV are described. The theoretical model is found to reflect the basic principles of the interaction process correctly, and to agree sufficiently well with the experimental findings.

References 12: 11 Russian, 1 Western.

[224-6900]

UDC: 535.21

DROPLET EVAPORATION IN DIFFUSE MODE BY INTENSE OPTICAL RADIATION CONSIDERING TEMPERATURE RELATIONSHIPS OF THERMOPHYSICAL PARAMETERS

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 29, No 1, Jan 85 (manuscript received 13 Feb 84) pp 50-53

PUSTOVALOV, V.K. and ROMANOV, G.S., Belorussian Polytechnical Institute, Scientific Research Institute for Applied Physical Problems imeni A.S. Shevchenko.

[Abstract] This study examines the heating and evaporation of spherical particles and droplets in the diffusion mode by intense optical radiation with allowance for the real variation with temperature of the coefficient of heat conductivity of the gas surrounding the particle and the coefficient of diffusion of the particle vapor in the gas. A system of equations is derived that describes the heating and evaporation process of a spherical particle by optical radiation. The evaporation of a drop of water in air subjected to continuous optical radiation at  $\lambda = 10.6 \mu\text{m}$  is examined. The experimentally observed change in radius as a function of time agrees well with the analytical findings, indicating that diffusion evaporation describes droplet evaporation accurately enough within the temperature interval  $T_{\infty} < T_0 < T_k$ . References 10 Russian.  
[234-6900]

UDC: 772.932.45:621.373.826.038.825

ERASURE OF HOLOGRAPHIC RECORDING ON PHOTOTHERMOPLASTIC MEDIA BY INFRARED RADIATION FROM A SOLID STATE LASER

Minsk VESTSI AKADEMII NAVUK BSSR SERYYA FIZIKA-MATEMATYCHNYKH NAVUK in Russian No 6, Nov-Dec 84 (manuscript received 18 Jan 83) pp 80-84

ZHDANOVICH, S.N. and KOVALEV, A.A., Institute of Electronics, Belorussian SSR Academy of Sciences.

[Abstract] The erasure of holographic information on photothermoplastic media using infrared radiation at  $\lambda = 1.06 \mu\text{m}$  produced by a garnet pulse laser is reported. The experimental setup was arranged to permit the erasure kinetics to be studied and the change in the diffraction efficiency to be traced during the laser pulse. The experimental results demonstrate the possibility of erasing the geometric relief on the surface of the working layer of a thermoplastic medium by means of laser radiation. The method is also suitable for recording on thermoplastic media. References 5: 3 Russian, 2 Western.  
[216-6900]

INFLUENCE OF LASER RADIATION WAVELENGTH ON PARAMETERS OF FORMING PLASMA

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 10, No 23,  
12 Dec 84 (manuscript received 26 Jun 84) pp 1420-1430

DOBKIN, A.V. and NEMCHINOV, I.V., Institute of Terrestrial Physics imeni  
O.Ya. Shmidt, USSR Academy of Sciences.

[Abstract] A wide range of laser radiation quantum energies  $\epsilon_0 = 1 - 300$  eV is investigated for moderate flux densities ( $10^8 - 10^{10}$  W/cm<sup>2</sup>) and durations of up to 0.1 - 1  $\mu$ sec in support of a theoretical study of the processes underlying the interaction of monochromatic radiation at different wavelengths with a barrier. Inverse bremsstrahlung is found to be the dominant mechanism for longwave radiation. The absorption of harder radiation by vapor at low temperatures is determined by photoionization. In the constant-mass heating condition, the plasma temperature is found to increase rapidly; as the quantum energy increases the plasma temperature drops and the pressure increases on the surface of the obstacle. The estimates and numerical calculations indicate that the plasma parameters vary nonmonotonically as the laser radiation quantum energy. References 8 Russian.

[235-6900]

WORK ON PARTICLE INTERACTIONS IN GASES MERITS PRIZE NOMINATION

Kiev PRAVDA UKRAINY, 12 Oct 85 p 2

KADOMTSEV, B., academician

[Excerpt] Processes of the collision of electrons with atoms and molecules underlie physical phenomena that take place in cosmic plasma, gas lasers, plasma-chemical reactors, high-temperature plasma of controlled thermo-nuclear reactors, etc.

It is gratifying to realize that Soviet science holds a leading place in this field of research. A solid contribution to it has been made by Ukrainian physicists, particularly the authors of the cycle "Elementary Processes of Inelastic Interaction of Electrons with Atoms and Molecules of Atmospheric Gases." This work was done by personnel of a number of the republic's institutes and universities.

It all began from scratch with the development of research units and methods. Unique physics units were developed, as well as compact sources of electron beams with a wide range of energies, and sources of thermal and supersonic atomic and molecular beams, many of which are protected by certificates of invention. A whole series of high-precision miniature monochromators and analyzers of low-energy electrons was assembled. These instruments have no counterparts abroad.

That results of purely basic research were brought to the stage of practical introduction is a distinctive feature of the cycle. Its reference data are being actively used in the development of new technology and the study of space and laboratory plasma at various Soviet organizations and enterprises. Recommendations for diagnosing low-temperature plasma have been successfully incorporated in "Bulat" industrial units and have made it easier to ascertain mechanisms of physics processes.

This research-cycle, which has been nominated for the Ukrainian SSR State Prize, is characterized by scientific profundity of ideas. This has been combined with broad introduction of results of this research in science and the economy, in the accomplishment of applied tasks.

FTD/SNAP  
/9716  
CSO: 1862/81

LASERS

UDC: 621.378.325

GENERATION OF RADIATION IN THERMAL PHASE LIGHT-INDUCED STRUCTURES

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian Vol 5, No 2, Apr-Jun 84  
(manuscript received 16 Jun 82) pp 90-93

KARAMALIYEV, R.A. and SHUKYUROV, N.M., Azerbaydzhhan State University imeni S.M. Kirov.

[Abstract] The generation of radiation in thermal phase structures occurring as the result of interference when a substance is irradiated by two coherent light beams is investigated theoretically. The temporal behavior of the radiation density is analyzed, showing that the lasing mode oscillates for near-threshold pumping. As the pumping power increases, the pulsations in the laser radiation disappear and the temporal behavior becomes smooth.

References 6: 2 Russian, 4 Western.  
[176-6900]

SPECTRALLY LIMITED InGaAsP/InP DUAL HETEROSTRUCTURE INJECTION LASERS WITH 300 A/cm<sup>2</sup> THRESHOLD (QUADRUPLE-CLEAVED SPECIMENS,  $\lambda = 1.25 \mu\text{m}$ , T = 300K)

Leningrad FIZIKI I TEKHNIKA POLUPROVODNIKOV in Russian Vol 18, No 11, Nov 84  
(manuscript received 29 Jun 84) pp 2057-2060

ALFEROV, Zh.I., ARSENT'EV, I.N., GARBUTOV, D.Z., YEVTIKHIYEV, V.P., SULIMA, O.V., CHALYY, V.P. and CHUDINOV, A.V., Physical-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences.

[Abstract] Injection lasers made from isotropic spectrally limited InGaAsP/InP dual heterostructures produced by liquid epitaxy are investigated. It is found that if there are no output losses, the lasing thresholds in InGaAsP/InP dual heterostructures can be reduced to 300 A/cm<sup>2</sup>. The reduction in thresholds in such lasers with 10 active regions is interpreted as resulting from inverse population and compensation for absorption losses in the valence zone of the active region. The concentration of nonequilibrium charge carriers at the lasing threshold is found to be little greater than in dual heterostructure lasers with active regions 0.3  $\mu\text{m}$  thick. References 7: 5 Russian, 2 Western.  
[175-6900]

## WORK ON FEMTOSECOND LASERS AT VIL'NYUS UNIVERSITY VIEWED

Moscow KOMSOMOL'SKAYA PRAVDA (Lithuanian) in Russian No 1, 1 Jan 85 p 1

[Article by Al'gis Piskarskas, Professor, Doctor of Physical-Mathematical Sciences, head of the laser research center of Vil'nyus University imeni Kapsukas, USSR State Prize laureate]

[Abstract] The author reviews the progression of advances in shortening the duration of laser pulses from the nanosecond to picosecond to femtosecond ranges at the laser research center of Vil'nyus University over the past 20 years. He notes, for example, that candidates of physical-mathematical sciences Romual'das Daniyelyus and Val'das Sirutkaytis, two former students of the university, made important contributions to the development of femtosecond and picosecond lasers, which was the first Lithuanian republic work to be awarded the USSR State Prize.

Physicists, mathematicians, chemists, biologists, and medical personnel are all involved in the development of lasers for various branches of science at the university's laser research center. A picosecond laser spectrometer was developed for measuring very rapid jumps of electrons, for example. The speed of electrons over a distance of 20 angstroms reportedly has been measured with this instrument. Personnel of the center have been using computers in work on laser methods for studying crystals in which electron jumps occur that are still more rapid, the author relates. A femtosecond parametric laser employing new crystals and pumping sources has been designed for this purpose. Such a unit is capable of emitting a pulse only 200 femtoseconds in duration.

(A photograph of the author is given.)

FTD/SNAP  
CSO: 1862/218

## CHEMICAL CHAIN-REACTION LASER R&D AT FIAN

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 1 Jan 85 p 2

[Excerpt] The year 1984 was a special one for Doctor of Physical-Mathematical Sciences A. Orayevskiy, head of a department of the USSR Academy of Sciences' Physics Institute imeni Lebedev. He and a group of scientists were awarded the Lenin Prize for their work "Basic Research of Chemical Chain-Reaction Lasers." Our correspondent S. Maslyuk met with Anatoliy Nikolayevich on the eve of the new year and invited him to answer a number of questions.

"The goal you dreamed of and worked toward for many long years has been achieved. Would you please tell what was distinctive about this work?"

"Several types of lasers exist, but they all have one characteristic feature: energy must be pumped into the working medium of a laser before it begins to operate, and then extracted in the form of a monochromatic beam with high directivity. But couldn't a quantum generator be developed which would require no influx of energy from outside, but would operate on its own store? The idea of the chemical laser was thus born; after all, liberation of heat occurs in many chemical reactions. If, for example, hydrogen is selected as fuel and fluorine as an oxidizing agent, a chain reaction with great liberation of energy is obtained."

"Where can chemical lasers be employed?"

"Their sphere of applications is very diverse. The problem of initiating thermonuclear reactions, for example, is now being worked on all around the world; the thermonuclear target of a thermonuclear reactor must be compressed and heated very rapidly in order to make it operate. There are plenty of candidates for the role of initiator of thermonuclear fusion. It is possible that a chemical laser will become one of them. Or take another example. The presence of a molecule with a certain composition in a gas mixture can be determined with the aid of chemical lasers. This means that emissions of harmful substances into the atmosphere can be monitored. Possibilities for the use of lasers of this type are innumerable; they can control chemical processes, be useful in medicine and biology, operate in space, and do many, many other things. They are already being used in practical work, and the list of their 'occupations' is becoming longer and longer."

"And what is to be done next?"

"We have developed chemical chain-reaction lasers which are now the best of all of this type that exist. But this does not mean that we have solved all problems completely. There are still many questions of concern to us, and there is no shortage of ideas either. For example, the problem is now being solved of developing chemical lasers whose reaction products would be non-toxic and could be discharged directly into the atmosphere without passing through absorbents. Another direction is also interesting. As is known, up until now laser radiation has been generated only in the frequency range that is invisible to the human eye. Researchers are pursuing work aimed at 'teaching' chemical lasers to generate electromagnetic radiation in the visible range. This will further expand the sphere of applications of lasers of this type."

FTD/SNAP  
CSO: 1862/218

## NUMERICAL MODELING OF CHARACTERISTICS OF CO<sub>2</sub> WAVEGUIDE LASER

Moscow AKADEMIYA NAUK SSSR INSTITUT OБSHCHEY FIZIKI. Preprints in Russian No 44,  
(signed to press 9 Jan 84)

KONEV, Yu.B., LIPATOV, N.I., PASHININ, P.P. and PROKHOROV, A.M., Institute  
of General Physics, USSR Academy of Sciences.

[Abstract] The characteristics of the linear amplification mode, as well as the lasing mode, of typical CO<sub>2</sub> waveguide lasers are modeled numerically assuming no degradation of the working mixture of the laser during the discharge process. The modeling is based on balance equations for the average number of vibrational quanta, taking into account the flow of quanta to levels above the minimum of the trinor distribution function of the asymmetrical mode of the CO<sub>2</sub> molecule. The assumption of severe degradation of the working mixture of the laser when pumping power densities are high results in a divergence between theoretical and experimental results. The influence of the diameter of the discharge channel on the lasing power is insignificant for a helium-rich 1:1:8 mixture; however, a 1.5-mm waveguide is found to provide approximately 20% higher lasing power than a 2.0-mm waveguide for a 1:1:3 helium-poor mixture. References 18: 10 Russian, 8 Western.

[332-6900]

## RECOMBINATION PUMPING DURING AMPLIFICATION OF LIGHT IN FULLY IONIZED PLASMA

Moscow AKADEMIYA NAUK SSSR INSTITUT OБSHCHEY FIZIKI. Preprints in Russian  
No 52. (signed to press 3 Jan 84)

MUKHTAROV, Ch.K., Institute of General Physics, USSR Academy of Sciences.

[Abstract] The possibility of lasing during the recombination of a fully ionized plasma is analyzed theoretically. Plasma parameters are found analytically for which the gain exceeds the critical value; the electron density is such that maximum gain is achieved; and the plasma is ideal and the approximation of a shock-radiation model can be employed. It is found that recombination pumping in a fully ionized plasma is ineffective for far-UV light amplifying media with gain exceeding 1 cm<sup>-1</sup>. It is recommended that other means be found to create inversion in such media; however, lasing in the far-UV range does not require such high gain. References 4 Russian.  
[332-6900]

UDC 621.375.826

INVESTIGATION OF SPECIFIC POWER OF GAS DYNAMIC CO<sub>2</sub> LASER EMPLOYING TAPERED AND SHAPED NOZZLES

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 3, Mar 85  
(manuscript received 3 Jan 84) pp 364-369

GORYACHYEV, S.B., YEFRYEMOV, N.M., KARPUKIN, V.T., RODIONOV, N.B., CHYERNYSHEV, S.M. and SHARKOV, V.F., Institute of High Temperatures, USSR Academy of Sciences

[Abstract] The specific energy output is compared for gas dynamic lasers employing nozzles in which the supersonic part is tapering or profiled, and a profiled nozzle array of miniature blades. It is found experimentally that large tapered monolithic nozzles provide an extremely high specific energy output. In view of their ease of manufacture and their operating advantages (such as the possibility of implementing a reliable nozzle cooling system), such nozzle design is recommended for technological CW lasers. References: 12 Russian.  
[355-6900]

UDC 621.372.8.02

LASER WITH DYNAMIC DISTRIBUTED FEEDBACK FORMED BY COUNTER-PROPAGATING PUMPING BEAMS

Kiev UKRAINSKIY FIZICHESKIY ZHURNAL in Russian Vol 29, No 7, 1984 (manuscript received 19 Sep 83) pp 988-993

BONDAR, M.V., VOVK, L.V., ZABELLO, Ye.I., TIKHONOV, Ye.A., Institute of Physics, Ukrainian SSR Academy of Sciences

[Abstract] The effectiveness of dynamic distributed feedback formed by the interference between two waves in the active medium is investigated in cavity lasers. The characteristics of distributed feedback lasers employing counter-propagating pumping beams are compared with those of lasers employing following beams. The latter are found to provide significant advantages in gain, lasing line width and emission divergence. A scheme is developed in which the lasing wavelength is relatively independent of uncontrollable temperature fluctuations and mechanical vibration and in which the delay between the interfering beams is small, permitting the use of ultrashort pumping pulses. This scheme is useful for exploratory experiments on dynamic periodic structures and for working with media having small optical densities at the pumping frequencies. References 10: 8 Russian, 2 Western.  
[304-6900]

TUNABLE CW COLOR CENTER LASER OPERATING IN 2.5-2.75  $\mu\text{m}$  BAND

KRATKIYE SOOBSHCHENIYA PO FIZIKE in Russian No 8, 1984 (manuscript received 28 May 84 after revision) pp 52-55

BAYEV, V.M., VYELICHANSKIY, V.L., ZIBROV, A.S., KIRYEV, A.N., NIKITIN, V.V., PROTSEYENKO, Ye.D., ROGOZHIN, A.A. and SAUTYENKOV, V.A.

[Abstract] A single-frequency tunable CW laser operating in the 2.5-2.75  $\mu\text{m}$  band is developed for use in precision spectroscopy. The laser employs  $F_A(\text{II})$ -centers, with the emitted spectrum narrowed by stabilizing the lasing frequency by the transmission resonances of a confocal scanning interferometer. The laser is based on additive-colored KCl:Li crystals. The tuning curve of the laser exhibits discontinuities caused by the absorption lines of water vapor. Two or three axial modes are observed simultaneously with a single selecting element in the cavity (a prism). The lasing line width is less than 4 MHz, which corresponds to the width of the confocal scanning interferometer. References 7: 2 Russian, 5 Western.

[303-6900]

SIMILARITY CRITERIA AND WAYS OF OPTIMIZING PULSED GAS DISCHARGE LASERS

Moscow AKADEMIYA NAUK SSSR INSTITUT OБSHCHEY FIZIKI, Preprint No 216 in Russian, 1984 (signed to press 8 Aug 84)

KRAVCHENKO, V.F.

[Abstract] Similarity criteria are obtained for a binary active medium employed in a pulsed gas discharge laser. The experimental findings are systematized using a Cu-Ne laser as an example, and ways of optimizing such lasers are analyzed. Similarity criteria are derived for thermal processes that govern the maximum average laser power. It is found that self-heating lasers provide greater average lasing power than lasers in which the discharge channel is heated additionally. The maximum average power increases proportionally as the cross-section of the discharge channel, and is limited by overheating of the active medium. References 27: 22 Russian, 5 Western.

[309-6900]

GENERATION OF SUBPICOSECOND PULSES IN NEODYMIUM GLASS LASER WITH SOLID STATE-LIQUID PHOTOTROPIC SHUTTER

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4, 26 Feb 85 (manuscript received 26 Jun 84) pp 234-237

AL'TSHULER, G.B., DUL'NEVA, Ye.G., KARASEV, V.B., OKISHEV, A.V. and TELEGIN, L.S.

[Abstract] The generation of subpicosecond spectrum-limited pulses in a passive mode-locked neodymium glass laser is examined. The laser employed a new type of phototropic shutter in which organic dye molecules are introduced into a matrix consisting of liquid-impregnated microporous quartz glass 1 mm thick. Single pulses with durations of 0.5 - 1 psec were obtained. The experiments indicate that this type of shutter supports stable generation of subpicosecond pulses, and that it improves the selection of the fundamental transverse mode. Because of the high heat conductivity of the matrix, the average lasing power density in the frequency-pulse mode can be as high as  $5 \text{ K/cm}^2$  with no significant thermal optical reflections in the passive shutter. References 7: 5 Russian, 2 Western.  
[247-6900]

PHASE-LOCKING OF TWO-DIMENSIONAL SYSTEM OF CO<sub>2</sub> WAVEGUIDE LASERS

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4, 26 Feb 85 (manuscript received 2 Sep 84) pp 249-252

GLOVA, A.F., DREYZIN, Yu.A., KACHURIN, O.R., LEBEDEV, F.V. and PIS'MENNYY, V.D.

[Abstract] This study describes coherent lasing in a two-dimensional system of CO<sub>2</sub> waveguide lasers. A multi-pass CO<sub>2</sub> waveguide laser, excited by a capacitive discharge, consisting of 61 glass tubes in a honeycomb arrangement spaced 8.5 mm apart is described. An interference picture occurs in the focal plane, indicating the presence of a coherent component in the radiation of the laser. The mirror placement is identified for which the amount of radiation passing from one element to its neighbor through the coupling mirror becomes sufficient to establish a common type of oscillation in the complex cavity that is formed. The threshold radiation achieved is approximately twenty-five times greater than the energy coupling coefficient of two coherent CO<sub>2</sub> waveguide lasers. References 11: 6 Russian, 5 Western.  
[247-6900]

InGaAsP/GaAs DUAL HETEROSTRUCTURE BAND LASERS ( $\lambda \approx 0.87 \mu\text{m}$ ) WITH THIN ACTIVE REGION

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI, in Russian Vol 11, No 4, 26 Feb 85 (manuscript received 19 Nov 84) pp 205-209

ALFEROV, Zh.I., ARSENT'YEV, I.N., VAVILOVA, L.S., GARBUZOV, D.Z., TIKUNOV, A.V. and TULASHVILI, E.V., Physical-Technical Institute imeni A.F. Ioffe, USSR Academy of Sciences.

[Abstract] This study cites the results of an initial investigation of the parameters of band lasers based on separate-confinement dual heterostructure InGaAsP/GaAs structures. The structures were grown on n-GaAs substrates with (111) orientation. The lasers were produced by applying an  $\text{SiO}_2$  layer to the surface of the structure. The minimum threshold current densities observed in specimens with long cavities were  $1.1 - 1.3 \text{ kA/cm}^2$ . Reducing the cavity length to  $100 \mu\text{m}$  increased  $I_{\text{th}}$  by a factor of 1.5 - 2 as compared with long lasers; lasers with long as well as short cavities exhibited high differential efficiency. The maximum continuous lasing power comprised 20 mW for a clamped heat sink, and 48 mW for a soldered specimen. References 6 Russian.  
[247-6900]

UDC: 621.373:535

INFLUENCE OF GEOMETRY OF ACTIVE ELEMENT ON RADIATION PARAMETERS OF GAS-DISCHARGE LASERS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 12 May 83) pp 1056-1059

PRIVALOV, V.Ye. and CHULYAYEVA, Ye.G.

[Abstract] A model is proposed for the radiation frequency shift of a helium-neon laser as a function of the pressure and composition of the mixture that explains the influence of the geometry of the active element on the frequency shift. The gas separation effect is interpreted as causing frequency shifts in helium-neon lasers, with the main role being played by the distribution of the neon along the discharge, rather than the distribution of the overall pressure or partial pressure of the helium. Measurements performed by optically heterodyning the radiation from two lasers with neon absorption cells to validate the model are described. The use of the same scheme to investigate shifts in the center of the Doppler neon contour as a function of helium pressure is explained. It is confirmed that the main contribution to the frequency shift comes from redistribution of the partial pressure of the neon along the discharge, so that the wavelengths of helium-neon lasers that are stabilized by the characteristic points of the Doppler radiation contour can differ, even with the same filling pressure. A pressure of about 800 Pa is recommended for filling the absorption cells in stabilized lasers. References 14: 9 Russian, 5 Western.  
[236-6900]

TUNABLE LASER R&D AT ESTONIAN PHYSICS INSTITUTE

Riga SOVETSKAYA ESTONIYA, 31 Mar 85 p 1

MOPPEL', Kh. (Tartu)

[Abstract] The article reports on research of tunable lasers which is being pursued by a group of physicists and engineers of the Institute of Physics in Tartu. Yevgeniy Berik, a physicist and head of this group, is credited with the development of dozens of lasers. A conversation with Berik is recorded in which he commented on the group's developments. It is noted that the institute has a special design bureau, which has facilitated the development and production of prototypes of lasers.

It is recalled that Berik developed an interest in lasers as a student at the Moscow Physical-Technical Institute. After working for a time at the Institute of Spectroscopy in Moscow, he moved to Tartu in 1979. He recently completed a candidate dissertation. Berik's research group was organized in connection with a tunable-laser development program headed by K. Rebane, president of the Estonian Academy of Sciences. Work in line with this program began in Estonia in 1980. Developments of the Estonian scientists are now in use not only in Soviet research centers but also in Finland. Berik was a member of a group which was awarded the 1984 Leninist Communist Youth League Prize for development and introduction of tunable lasers. This group also included young scientists of Moscow and Minsk.

A photograph of Berik is given.

FTD/SNAP  
/9716  
CSO: 1862

UDC 535.15

BLEACHING OF COLOR CENTERS IN NEODYMIUM GLASS LASER

Tbilisi SOOBSHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 115, No 2, Aug 85 (manuscript received 2 Sep 83) pp 265-268

DZHIBLADZYE, M.I., MSHVELIDZYE, G.G., ERIKASHVILI, R.R. and ESIASHVILI, Z.G., Tbilisi State University

[Abstract] The mechanism underlying the bleaching of short-lived color centers in a neodymium glass laser, which causes passive Q-modulation of the cavity, is investigated. Experiments to investigate the amplification of series of short-lived light pulses by neodymium glass fibers are described. It is found that the gain of the laser drops off monotonically toward the end of the pulse train in the absence of color centers, but that in the presence of color centers the micropulses at the front of the chain are amplified significantly more weakly than subsequent micropulses. It is concluded that passive Q-modulation by short-lived color centers in neodymium glass lasers results mainly from destruction by emission from the neodymium. Figures 2, references: 5 Russian. [275-6900]

UDC 621.378.325

A NONLINEAR THEORY FOR FREE-ELECTRON LASERS WITH COUNTER-PROPAGATING SIGNAL WAVE

Leningrad ZHURNAL TEKHNICHESKIY FIZIKI in Russian Vol 55, No 1, Jan 85 (manuscript received 29 Mar 84) pp 47-52

GINZBURG, I.S., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] This study investigates the characteristics of energy exchange between a relativistic electron beam and electromagnetic waves in free-electron lasers based on stimulated undulator emission (Ubitrons) and stimulated wave scattering (scattrons). Two types of combination synchronism are possible in these devices: one of which occurs when the phase velocity of the pumping wave exceeds the translational velocity of the particles, and the other of which occurs when the pumping wave is so slow that its phase

velocity is less than the particle velocity. The latter is the case in Ubitrons. In the former case, the energy of the pumping wave is absorbed by the electron beam; in the latter, a fast space-charge wave is excited. The signal and pumping amplitudes increase simultaneously for a slow pumping wave because of the electron beam energy. A self-consistent system of equations for a free-electron laser with a counter-propagating wave is presented. The approximation of fixed and variable amplitude of the pumping wave is described. The parameters of a system in which the emission of a neodymium laser is scattered in a vacuum on a strong-current relativistic electron beam are estimated as an example. Figures 2, references: 11 Russian.  
[261-6900]

UDC 621.378

OPEN DISCHARGE GENERATING ELECTRON BEAM: MECHANISM, PROPERTIES AND USE FOR PUMPING MEDIUM-PRESSURE LASERS

Leningrad ZHURNAL TEKHNICHESKII FIZIKI in Russian Vol 55, No 1, Jan 85  
(manuscript received 20 Feb 84) pp 88-95

BOKHAN, P.A. and SOROKIN, A.R., Institute of Thermophysics, Siberian Department, USSR Academy of Sciences

[Abstract] This study investigates the discharge mechanism in small gas intervals at pressures corresponding to the left branch of the Pashen curve, and the generation of electron beams in such discharges. The principal stress is on a qualitative physical interpretation of the phenomena observed. The type of discharge in question is called open because of the presence of a drift space outside the discharge interval. A new method is described for obtaining an electron beam in the discharge between the grid cathode and an external bulk charge that is positive with respect to the small discharge interval. Aspects of the use of these electron beams for laser pumping are examined. Figures 2, references: 9 Russian.  
[261-6900]

UDC 537.521

THRESHOLD CONDITIONS FOR IGNITION AND PROPAGATION OF OPTICAL DISCHARGE IN NEODYMIUM LASER BEAM

Leningrad ZHURNAL TEKHNICHESKIY FIZIKI in Russian Vol 55, No 1, Jan 85  
(manuscript received 7 Mar 84) pp 96-102

BUFETOV, I.A., PROKHOРОV, A.M., FEDOROV, V.B. and FOMIN, V.K., Institute of General Physics, USSR Academy of Sciences

[Abstract] This study describes the experimental investigation of an optical discharge maintained by neodymium laser radiation. The development of the discharge was investigated by high speed photography of the plasma glow. The length of the discharge was determined as a function of the propagation time and velocity of the discharge fronts. The power of the incident radiation and the radiation passing through the discharge were recorded and used to find the coefficient of absorption of the plasma. It was found that the temperature of the discharge plasma is the same for all investigated diameters near the propagation threshold, because of the abrupt reduction in the stream of plasma radiation that moves the front of the discharge. The power absorbed by the discharge and the discharge plasma temperature are found to depend little upon the intensity of the incident radiation for intensities above the threshold because of the rapid drop in absorption in the plasma as the intensity increases. It is found that an optical discharge at  $\lambda=1.06 \mu\text{m}$  can be sustained with powers of the order of 0.1 MW. Such low discharge thresholds make it possible to use them to obtain neodymium lasers with lasing parameters easily achievable at present. Figures 4, references 13: 11 Russian, 2 Western.  
[261-6900]

UDC 537.52:535.89

THERMAL MODE OF WAVEGUIDE CO<sub>2</sub> LASER

Leningrad ZHURNAL TEKHNICHESKIY FIZIKI in Russian Vol 55, No 1, Jan 85  
(manuscript received 10 May 84 after revision) pp 103-106

AGEYEV, B.M., DANILOV, O.B., ZATULOVSKIY, L.M. and RUBINOV, Yu.A.

[Abstract] A theoretical assessment is made of the influence of the thermal conductivity of the wall material on the thermal balance of the active medium in a waveguide CO<sub>2</sub> laser. It is found that changes in the thermal mode has no significant influence on the laser power when materials with heat conductivity exceeding 10 W/m·K, such as sapphire, are used. A leucosapphire-waveguide laser is developed on the basis of the findings. The laser, consisting of two identical flat dielectric mirrors placed 2.5 mm from the ends of the waveguide, yielded running emission power of 22 W/m with diffusion cooling of the active medium. Figures 1, references 13: 6 Russian, 7 Western.  
[261-6900]

POWERFUL QUASI-CW LASING IN VISIBLE REGION OF SPECTRUM WITH HIGH PRESSURE  
INERT GASES MIXTURE

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian  
Vol 41, No 4, 25 Feb 85 (manuscript received 15 Jan 85) pp 156-158

BASOV, N.G., ALEKSANDROV, A.Yu., DANILYCHEV, V.A., DOLGIKH, V.A., KERIMOV, O.M.,  
MYZNIKOV, Yu.F., RUDOV, I.G. and SOROKA, A.M., Physics Institute P.N. Lebedev,  
USSR Academy of Sciences.

[Abstract] An He/Ne/Kr(Ar) mixture was excited by an electron beam with current density  $\sim 10^{-3} - 10 \text{ A/cm}^2$ , pulse length of 0.5-200  $\mu\text{sec}$ , and average electron energy of approximately 200 keV. The lasing spectra were recorded spectrographically, and the lasing energy was measured by a 20 mV/J calorimeter. Powerful quasi-CW lasing with efficiency of approximately 1% was achieved. It was shown possible to achieve rapid selective depopulation of the resonant 3s states of Ne with electron release. Selective population of higher lasing levels is achieved by dissociative recombination of the electron with the molecular neon ion. The maximum efficiency is achieved at  $\lambda = 5852.5$  angstroms. References 7: 4 Russian, 3 Western.

[337-6900]

MAGNETOHYDRODYNAMICS

UDC: 537.84

TRANSITION TO TURBULENCE IN CHANNELS AND WIND TUNNEL

Riga MAGNITNAYA GIDRODINAMIKA in Russian No 4, Oct-Dec 84 (manuscript received 2 Jan 84) pp 70-74

BERSHADSKIY, A.G.

[Abstract] The transition to turbulence is investigated for channels with circular, rectangular and triangular cross-sections (with and without a magnetic field), as well as the flow about a sphere in a wind tunnel. It is found that there are several possible types of transition caused by the initial turbulent background. Good agreement is established between the analytical and experimental findings. A single dimensionless constant is selected from the experimental findings for each type of flow. References 8: 6 Russian, 2 Western.

[222-6900]

'ANTISYMMETRICAL' AMBIPOLE TRAP

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 41, No 1, 10 Jan 85 (manuscript received 20 Oct 84) pp 13-15

SKOVORODA, A.A.

[Abstract] The possibility of creating a locally embedded classical ambipolar trap with an antisymmetrical relationship  $g(z) = -g(-z)$  is investigated. The case of local orthogonality (embeddedness) for the symmetrical case is written in the approximation of small multipolarity; a function satisfying this condition is derived in paraxial approximation that is antisymmetrical and forms MHD unstable configurations. The proposed system is shown to eliminate the neoclassical losses, longitudinal currents and multipolar component in ordinary quadrupole traps. References 3: 2 Russian, 1 Western.

[237-6900]

MHD OSCILLATIONS ON PERIPHERY OF PLASMA FILAMENT IN L-2 STELLARATOR DURING OHMIC HEATING

Moscow AKADEMIYA NAUK SSSR, INSTITUT OBUHCHEY FIZIKI, Preprint No 178 in Russian, 1984 (signed to press 12 Jun 84)

GREBENSHCHIKOV, S.Ye., KORNEV, B.I. and SHCHEPETOV, S.V., Institute of General Physics, USSR Academy of Sciences.

[Abstract] Fluctuations of the poloidal magnetic field in the L-2 stellarator in ohmic plasma heating modes are investigated experimentally. The field fluctuations were measured by a system of magnetic probes placed near the exterior surface of the vacuum discharge chamber. The measurements were processed automatically by computing the cross-correlation functions of the probe signals and performing Fourier-series expansion. The current density perturbations are found to be of the spiral mode ( $m, n$ ) type. The poloidal and toroidal numbers of the perturbations are relatively large, and depend upon the ohmic heating current and the small radius of the plasma. The experimental findings are in complete accord with contemporary theoretical conceptions of the principles underlying the dynamics of resistive MHD instabilities in stellarators. References 18: 11 Russian, 7 Western.

[306-6900]

MOLECULAR PHYSICS

UDC 539.19

ROTATIONAL-VIBRATIONAL RESONANCES IN ELECTRON TRANSITION SPECTRA OF XeCl MOLECULES

Moscow DOKLADY AKADEMII NAUK SSSR, Vol 281, No 1, Mar 85 (manuscript received 20 June 84) pp 64-66

Academician N.G. BASOV, I.S. GORBAN<sup>1</sup>, V.A. DANILYCHYEV, N.G. ZUBRILIN, and M.G. CHERNOMORETS, Physics Institute imeni P.N. Lebedev, USSR Academy of Sciences

[Abstract] The rotational structure of the energy spectrum of XeCl molecules is established, providing new information on the dynamic properties of the XeCl molecule and to measure the parameters of the potential X-state function more accurately. The spontaneous luminescence and induced radiation spectra were obtained on two different systems - a beam system and an electric discharge system. The fine structure of the electron-vibrational bands in the spectra of spontaneous and induced emission of XeCl molecules is detected. The spectroscopic characteristics of the structure indicate the occurrence of resonant interaction between vibrational and rotational modes in the lower electron state. References 6: 2 Russian, 4 Western.  
[331-6900]

## NUCLEAR PHYSICS

### A. LOGUNOV VIEWS ELEMENTARY-PARTICLE, FUSION RESEARCH

Moscow TRUD in Russian No 1, 1 Jan 85 p 3

[Interview with Anatoliy Alekseyevich Logunov, vice-president of the USSR Academy of Sciences, president of Moscow State University and a laureate of the Lenin and State prices, by V. Vostrukhin]

[Text] Question: Could you make a scientific forecast: What discoveries in the field of physics are anticipated in the near future--in 1985, for example?

Answer: Before talking about the future, I should like to say a few words about the situation that now exists in physics. It is such that physicists and everyone else who is not a physicist are again unable to understand each other.

Question: In what sense?

Answer: In the most direct one. Whereas any high school student knows the words 'proton,' 'electron' and even 'neutrino,' as soon as we physicists start discussing esoteric subjects such as quarks and glueballs, we get astonished looks from other people. Because these words, which designate phenomena that are well-known and understood, are not to be found in any of the world's languages.

Question: Then let us introduce quarks and glueballs into the vocabulary of our readers, so to speak. What do these words mean?

Answer: Quarks are what protons, neutrons and all other elementary particles are made of, with rare exceptions.

Question: And glueballs?

Answer: They are hypothetical particles possessing mass, which will be discovered in the very near future. Experiments which indirectly confirm the possibility of glueballs' existence have already been conducted at the Institute of High-Energy Physics in Protvino."

\* See the daily SNAP, 10 December 1984, p 2.

Question: What practical consequences may stem from this new knowledge of the structure of matter?

Answer: For the time being, the only thing that can be said is that the energy of interaction of quarks is unusually great. It is substantially greater than nuclear energy. But how this energy is to be utilized is not clear yet. But you may expect that physicists will come close to achieving the Great Fusion during the new year, on the other hand.

Question: In other words, they will realize the dream of scientists of all ages and obtain evidence of the unity of forces that are known in nature?

Answer: I would say that this dream is beginning to be realized, little by little. The evidence you speak of can be obtained only in experiments with accelerators of sufficient capacity. Only with them can the units of electromagnetic and nuclear forces, for example, be confirmed.

Question: But what about gravitational forces? They are ones we have known about all our lives, it seems.

Answer: They are nevertheless more mysterious than any others. They do not manifest themselves anywhere in the microcosm as yet. Academician Markov has hypothesized that gravitational forces are connected with giant particles which are as yet unknown. These particles are many times heavier than quarks. He has tentatively named them 'maximons.'

Theoretical physicists recently introduced the concept of so-called Higgs particles 'for their own needs,' that is, to explain phenomena in the microcosm.

Question: What do you mean, 'introduced it?'

Answer: They hypothesized the existence of such particles. And if Higgs particles really do exist and possess the presumed properties, then they play an exceptional role in the evolution of the universe. They definitely determine its structure and development, its past and present. The construction of a giant synchrotron accelerator which may make the discovery of Higgs particles possible is to begin this year in Protvino, which is near Serpukhov in Moscow Oblast.

I shall mention still another important event which is anticipated by physicists all over the world. It is to take place in our country, and it has to do with substantiating a new principle of thermonuclear reactions.

You probably know that obtaining a thermonuclear reaction without tremendous heating in advance has long been known to be theoretically possible. Soviet physicists have now managed to gain a detailed understanding of the mechanism of this process and learn how to induce it artificially. However, we have not succeeded as yet in obtaining results of practical significance, that is, in achieving that type of reaction which could serve as a source of energy, like that of nuclear reactors which are now commonplace. Fundamentally new possibilities will open up in thermonuclear power engineering when this happens. One still cannot be completely sure that this anticipated success will be achieved, incidentally. Much research work still lies ahead.

UDC 539.171.017

INELASTIC INTERACTIONS OF HIGH ENERGY HADRONS WITH NUCLEONS AND NUCLEI OF  
PHOTOEMULSION AND THE CLUSTERIZATION PHENOMENON

Moscow AKADEMIYA NAUK SSSR ORDENA LENINA FIZICHESKIY INSTITUT IMENI P.N.  
LEBEDEVA, 1984 (signed to press 25 July 84) pp 3-48

MARIANNA IVANOVNA TRET'YAKOVA

[Abstract] The multiple generation of particles is investigated experimentally in inelastic collisions of hadrons (protons and ions) with hadrons and nuclei in the region of accelerator energies (10-400 Gev) and cosmic rays ( $10^3$ - $10^3$  Gev) by the nuclear photoemulsion method. Extensive information is obtained on the characteristics of inelastic interactions of hadrons over a wide range of proton and pi-meson energies. The total material analyzed comprised approximately 50,000 stars found along the trails of primary particles over a total length of about 18 km. Unique information is obtained on the multiperipheral cluster nature of inelastic processes in elementary events and on the space-time development of the formation of secondary particles and hadron structure, thus providing new information on the properties of strong interaction of elementary particles. References 60 Russian.  
[328-6900]

UDC: 539.12.088

COMPUTATION OF NUCLEAR LEVEL POPULATION DURING INELASTIC SCATTERING OF FAST  
REACTOR NEUTRONS

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR: SERIYA FIZICHESKIKH I  
TEKHNICHESKIKH NAUK in Russian No 1, Jan-Feb 85 (manuscript received  
20 May 84) pp 3-11

KUVAGA, I.L., Institute of Physics, Latvian SSR Academy of Sciences.

[Abstract] This study describes a collection of programs written for the SM-4 minicomputer, which is part of the IVK-2 measurement-computer complex, for calculating the nuclear level population during inelastic scattering of fast reactor neutrons. The software described is comprised of a program for

computing penetration coefficients using an optical model of the nucleus, a program for calculating the reaction cross-sections of inelastic scattering of fast neutrons according to a statistical model, and a program for calculating the level populations in the  $(n, n')$  reaction. These programs are being employed by the Laboratory of Nuclear Reactions of the Institute of Physics of the Latvian USSR Academy of Sciences for determining the spins of the nuclear states excited during inelastic scattering of fast reactor neutrons by comparing experimental and theoretical population values.

References 16: 7 Russian, 9 Western.

[248-6900]

UDC: 539.125.5:621.039.51

#### COMPLETE INTERACTION CROSS-SECTIONS OF ULTRACOLD NEUTRONS WITH GASEOUS DEUTERIUM

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSSKOGO SSR: SERIYA FIZIKO-MATEMATICHESKAYA  
in Russian No 6 , Nov-Dec 84 (manuscript received 24 Oct 83) pp 1-2

AKHMETOV, Ye.Z., BARSHENTSEV, V.N., KADYKENOV, M.M., KAIPOV, D.K., KAIPOV,  
M.D. and KOSPANOV, N.K., Institute of Nuclear Physics, Kazakh SSR Academy of  
Sciences.

[Abstract] The complete interaction cross-sections of ultracold neutrons moving at velocities of from 3.2 to 5.7 m/sec with gaseous deuterium are measured at 300 K (in an equilibrium mixture consisting of one-third paradeuterium and two-thirds orthodeuterium). The complete cross-sections are also analyzed for an equilibrium mixture of ortho- and para-modifications of deuterium as a function of temperature for average ultracold neutron velocity of 4.8 m/sec. The measurement results confirm the calculated cross-sections.

[255-6900]

UDC: 539.17.01

#### ELASTIC SCATTERING OF 50 MeV $\alpha$ -PARTICLES BY $^{14}\text{N}$ , $^{16}\text{O}$ , $^{20}\text{Ne}$ , $^{24}\text{Mg}$ and $^{28}\text{Si}$ NUCLEI

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSSKOGO SSR: SERIYA FIZIKO-MATEMATICHESKAYA  
in Russian No 6 , Nov-Dec 84 (manuscript received 30 Mar 84) pp 49-53

BURTEBAYEV, N.T., DUYSEBAYEV, A.D. and IVANOV, G.N., Institute of Nuclear  
Physics, Kazakh SSR Academy of Sciences.

[Abstract] The mechanism underlying the scattering of 50 MeV  $\alpha$ -particles on  $^{14}\text{N}$ ,  $^{16}\text{O}$ ,  $^{20}\text{Ne}$ ,  $^{24}\text{Mg}$  and  $^{28}\text{Si}$  nuclei is investigated over a wide range of angles. The experiment was conducted with an isochronous cyclotron beam

employing a multidimensional analysis system. The scattered  $\alpha$ -particles were recorded spectrometrically. The differential elastic scattering cross-sections of the  $\alpha$ -particles were measured at angles ranging from 10 to 170 degrees in 2 - 3 degree steps. The findings indicate that the potential parameters for  $\alpha$ -particles can be localized by using the energy relationship of the parameters of the optical model and the corresponding values of the volume integrals. References 7: 3 Russian, 4 Western.

[225-6900]

OPTICS AND SPECTROSCOPY

UDC: 536.3:541.182.3

EXPERIMENTAL INVESTIGATION OF RADIATION SCATTERING BY MULTICOMPONENT POLYDISPERSE SYSTEMS OF PARTICLES

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 6, Nov-Dec 84  
(manuscript received 11 Jul 83) pp 1146-1151

YUREVICH, F.B., YATSKEVICH, G.M., FOGELEV, V.A. and KARAS', S.M., Institute of Heat- and Mass-Exchange, Belorussian SSR Academy of Sciences.

[Abstract] An experimental setup is described for finding the relationship between the optical properties of heat protective materials on radiation wavelength, fractional composition, temperature, component concentration and other parameters. The optical properties of a three-component gas-and-dust mixture containing 36% carbon, 32% magnesium oxide and 32% silicon dioxide by weight are studied. The experimental method and software employed are described in detail. The optical properties of the gas-and-dust mixture were measured at disperse phase temperatures of 300 and 1200 K; cold-jet sounding was performed at  $\lambda = 0.633 \mu\text{m}$ , and hot-jet at  $\lambda = 0.488 \mu\text{m}$ . The scattering index for forward scattering is found to agree satisfactorily with the calculated values; the agreement is not as good for the  $\text{Sc}_\lambda$  criterion or the coefficient of asymmetry  $\eta_\lambda$ , which confirms the suitability of the spherical particles model and the method for determining the characteristic dimensions of the particles. The complex index of refraction is found to influence the effectiveness of screening radiation by a gas mixture through angular energy redistribution. References 14: 13 Russian, 1 Western.

[207-6900]

UDC: 631.375

ABSORPTIVE CAPACITY OF VIBRATIONAL-NONEQUILIBRIUM CARBON DIOXIDE GAS IN  
15-  $\mu\text{m}$  BAND Q-BRANCHES. ANALYTICAL METHOD

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 6, Nov-Dec 84  
(manuscript received 19 Sep 82) pp 1080-1087

KRYUCHKOV, S.I., KUDRYAVTSEV, N.N., NOVIKOV, S.S., Moscow Physical-Technical Institute.

[Abstract] A method is developed for calculating the absorptive capacity in the Q-branches of the 15-  $\mu\text{m}$  band of  $\text{CO}_2$  under vibrational-nonequilibrium conditions. The method is based on integrating the absorptive capacity over the spectrum line by line. The influence of the type of distribution function (symmetrical or deformation) in the combined mode of  $\text{CO}_2$  on the spectral absorbing capacity of the band in question is investigated. The type of distribution function with respect to the vibrational levels of the combined mode is found to have a strong influence on the spectral absorbing capacity of certain Q-branches. The errors occurring when a statistical model is used to calculate absorption in Q-branches do not exceed 10% for the spectral absorbing capacity, and 5% for the integral. References 19: 12 Russian, 7 Western.

[207-6900]

UDC: 539.196+621.375.826

LASER-SCHLIEREN MEASUREMENT OF OSCILLATION RELAXATION TIMES OF  $\text{N}_2\text{O}$  IN MIXTURES CONTAINING CO,  $\text{N}_2$  AND AR FOLLOWING AN INCIDENT SHOCKWAVE

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FIZIKA in Russian Vol 27, No 11, Nov 84 (manuscript received 14 Dec 83 after revision) pp 3-8

ZUYEV, A.P., NEGODYAYEV, S.S. and TKACHENKO, B.K., Moscow Physical-Technical Institute.

[Abstract] Laser-shliren measurement is employed to investigate the oscillation relaxation times in pure  $\text{N}_2\text{O}$  and mixtures of  $\text{N}_2\text{O}$  and CO,  $\text{N}_2$  and Ar. The experiments were conducted in a sectional shock tube made of stainless steel with an inside diameter of 50 mm, comprising a low-pressure chamber 4 meters long and a high-pressure chamber 1 meter long. The oscillation relaxation times were measured by recording the density gradient in the relaxation zone. A single-mode LG-52-1 helium-neon laser operating at 6328 Å was employed. The relaxation effectiveness of  $\text{N}_2$  was found to be close to that of  $\text{N}_2\text{O}$ ; CO was found to accelerate the oscillation relaxation of  $\text{N}_2\text{O}$ . Comparison with findings from the literature indicates good correspondence. References 15: 4 Russian, 11 Western.

[187-6900]

UDC: 528.721.28:535.241

IMAGE CONTRAST DISTRIBUTION BASED ON BRIGHTNESS FIELD ANALYSIS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 84  
(manuscript received 10 Aug 83) pp 8-10

SOZON-YAROSHEVICH, Ye.A.

[Abstract] This study presents an approach to finding the contrast distribution of an image that takes into account the type of brightness field in question (with respect to uniformity and isotropicity), as well as the type of distribution. It is found that the contrast distribution can be fully calculated from the unidimensional distribution and covariation function of the brightness field. Expressions are derived for the latter for an anisotropic inhomogeneous field. The expressions derived are also valid for the generalized contrast employed in the law of contrast light perception. References:

3 Russian.

[177-6900]

UDC: 528.714.2

ANALYSIS OF OPTICAL IMAGE MOVEMENT WITH RECORDING CAMERA MOVING ARBITRARILY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST in Russian No 8, Aug 84  
(manuscript received 29 Dec 82) pp 10-13

BATRAKOV, A.S. and SHVEDCHENKO, Ye.P.

[Abstract] The general problem is examined in which a camera aboard a moving platform moves arbitrarily, executing reciprocating as well as angular movements. Analytical formulas are derived for determining the velocity components of the optical image. These make it possible to estimate the specific contribution of each of the factors, to determine the errors resulting from various assumptions more accurately, and to analyze the requirements for image shifting compensation in detail. The general formulas for the velocity of the points of an optical image are based on the theory of linear spaces and linear transformations. It is shown that the method and algorithm developed for analyzing point velocities are valid for all possible types of photography. The influence of the rate of closure of the camera on the velocity of the recorded optical image is analyzed as an example. References: 5 Russian.  
[177-6900]

UDC: 535.44

DIFFRACTION OF LIGHT BY ULTRASOUND IN OPTICALLY ACTIVE UNIAXIAL CRYSTALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 12, Dec 84 (manuscript received 18 Apr 83) pp 2449-2454

ZILBERMAN, G.Ye., KUPCHENKO, L.F. and GOLTVYANSKAYA, G.F.

[Abstract] The diffraction of light by ultrasound is examined in uniaxial crystals exhibiting optical activity for small angles between the incident wave and the axis of the crystal (where optical activity masks diffraction phenomena) and for angles of the order of Bragg angles. Expressions are found for the fundamental and diffraction components of a light field. New Bragg angles are found that lie in the interval between the ordinary angles occurring for  $\epsilon_c = 0$ . The new Bragg angles observed differ significantly from the old values for gyration tensor component values that exceed the values for  $\text{TeO}_2$  by factors of several hundred. The nonmutual effect in the acoustic field is described; it is found that optical activity apparently does not change the order of nonmutuality. References 7 Russian.  
[179-6900]

OPTICAL PROPERTIES OF SOLID  $\text{PbSe}_{1-x}\text{Te}_x$  SOLUTIONS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 18, No 11, Nov 84 (manuscript received 3 May 84) pp 2104-2106

FARADZHEV, F.E., Azerbaydzhani State University imeni S.M. Kirov.

[Abstract] The transmission and reflection spectra of epitaxial films of  $\text{PbSe}_{1-x}\text{Te}_x$  are measured in the intrinsic absorption region at 77-300 K. Epitaxial films of  $\text{PbSe}_{1-x}\text{Te}_x$  were grown on freshly cleaved  $\text{BaF}_2$  substrates. The characteristics of the resulting films were similar to those of three-dimensional single crystals. The transmission and reflection were measured spectrometrically. The width of the forbidden zone is determined for different solid  $\text{PbSe}_{1-x}\text{Te}_x$  solution compositions. The theoretical relationship between the width of the forbidden zone and the composition of the solid solution agrees well with the experimental findings. References 7: 5 Russian, 2 Western.  
[175-6900]

UDC 535:621.373.8

LASERS EMPLOYING PLASMA MIRROR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 3, May 85 (manuscript received 16 Dec 83) pp 570-573

KRASYUK, I.K., and FISHYER, V.I., Institute of General Physics, USSR Academy of Sciences, Odessa University

[Abstract] The generation of high-power picosecond pulses in a cavity containing a plasma mirror is investigated theoretically; the principles of chain formation, i.e. the operation of the plasma optical element as a mirror and shutter, are clarified. The flat plasma layer occurring at the moment  $t=0$  at the caustic of the focusing lens is used as the model of the plasma optical element. Pulse durations of approximately 10-30 psec are obtained, with an impulse coefficient of reflection of the order of several percent. The analysis suggests that plasma optical elements can be used to form high-power, high-contrast isolated pulses in the picosecond range.

References 14: 11 Russian, 3 Western.

[349-6900]

UDC: 535.375.55

TRANSFORMATION OF LIGHT BEAM SPATIAL STRUCTURE DURING RAMAN SCATTERING

Moscow AKADEMIYA NAUK SSSR FIZICHESKIY INSTITUT. DISSERTATION ABSTRACT in Russian (signed to press 22 Feb 84)

OKLADNIKOV, Nikolay Vasil'yevych, Physics Institute imeni P.N. Lebedev, USSR Academy of Sciences.

[Abstract] The influence of the energy excitation conditions and the optical characteristics of active media in Raman scattering on wavefront conjugation of light beams is investigated experimentally. Means are sought for controlling the spatial structure of light beams during Raman scattering. Total 'back' saturation of Raman scattering is observed, in which the Raman scattering energy ceases to increase when the pumping pulse energy exceeds a certain value. A scheme is devised for wavefront conjugation during Raman scattering in which the volume of the scattering medium is separated into a volume that serves as a dynamic amplifying hologram and a volume that serves as the source of the conjugating coherent Raman scattering wave. Optimal conditions for image recovery during Raman scattering are identified. The recovery of images during Raman scattering in media with differing degrees of optical inhomogeneity is investigated. References 10 Russian.

[334-6900]

UDC: 621.373.826

INTRA-DOPPLER SPECTROSCOPY OF RESONANT ATOMIC LINES USING INJECTION LASER

Moscow AKADEMIYA NAUK SSSR INSTITUT OBSHCHEY FIZIKI. DISSERTATION ABSTRACT,  
in Russian (signed to press 22 Feb 84)

SAUTENKOV, Vladimir Alekseyevich, Physics Institute imeni P.N. Lebedev,  
USSR Academy of Sciences.

[Abstract] A tunable external-cavity injection laser is employed for intra-Doppler spectroscopy of resonant atomic lines, specifically the D-lines of potassium and cesium. A tunable injection laser with line width of less than 1 MHz is developed. Matching of the flat laser waveguide to the axisymmetrical external cavity is investigated analytically and experimentally. A number of methods are described for eliminating Doppler line broadening, linear as well as nonlinear, for the resonant lines of potassium and cesium. The intra-Doppler resonances of selective reflection on the D-lines of cesium and potassium are registered for low vapor pressures, where resonant broadening of the  $\gamma_c$  lines is smaller than the Doppler broadening  $\Delta\nu_D$ . The spectral behavior of the magnetic rotation of light polarization during selective reflection is registered. References 8: 6 Russian, 2 Western.

[334-6900]

INFLUENCE OF TYPE OF MATERIAL ABSORPTION SPECTRUM, LASING SPECTRUM AND CO-LASER POWER FLUCTUATION ON MEASUREMENT OF ABSORPTION COEFFICIENT OF SOLID STATE MATERIALS

Moscow AKADEMIYA NAUK SSSR INSTITUT OBSHCHEY FIZIKI. Preprint in Russian No 39  
(signed to press 3 Jan 84)

MASICHEV, V.I., PLOTNICHENKO, V.G. and SYSOYEV, V.K., Institute of General Physics, USSR Academy of Sciences..

[Abstract] This study demonstrates the influence of the type of absorption spectrum of the investigated material, the radiation spectrum of the CO-laser and the power instability of the lasing lines on the measurement of the absorption coefficients of highly transparent crystals (KCl, CsJ, KPC-6), as well as borosilicate glasses and fused quartz. It is found that the volumetric absorption coefficients of solid state materials can be measured with CO-lasers employing non-selective optical cavities in order to estimate the absorption level by an order of magnitude. Optical losses can be measured more accurately by using discretely tunable CO-lasers, in which case the spectral behavior of the optical losses can be investigated and used to identify impurities that have absorption bands within the spectral tuning range of the CO-laser.

References 16: 14 Russian, 2 Western.

[332-6900]

UDC 66.085.3

DEVELOPMENT OF LATENT IMAGE IN POLYMER FILMS BY VACUUM ULTRAVIOLET PHOTO-ETCHING

Moscow DOKLADY AKADEMII NAUK SSSR, Vol 281, No 1 (manuscript received 4 June 84) pp 71-74

USSR Academy of Sciences Corresponding member VALIYEV, K.A., VYELIKOV, L.V., DUSHYENKOV, S.D. and academician PROKHOROV, A.M., Institute of General Physics, USSR Academy of Sciences

[Abstract] A new method is described for forming images in polymer films based on vacuum ultraviolet photoetching of polymers and slowing the VUV photoetching rate by first subjecting the polymer film to soft X-radiation. The intensity distribution corresponding to the Fresnel diffraction indicates that the method provides good resolution. VUV etching is found to be more effective than liquid developing. The method is useful for X-ray holographic microscopy. References 12: 9 Russian, 3 Western.

[331-6900]

UDC 537.876.23.029.7:515.510.5

LASER BEAM THERMAL SELF-FOCUSING EFFECT

Moscow DOKLADY AKADEMII NAUK SSSR, Vol 281, No 1, Mar 85 (manuscript received 7 May 84) pp 60-63

USSR Academy of Sciences Corresponding member USTINOV, N.D., AVROV, A.I., GLOTOV, Ye.P., KOTEROV, B.N., KRASNOVSKIY, A.G., PRIGARIN, V. Ye., SOROKA, A.M. and CHEBURKIN, N.V.

[Abstract] The assumption that a rarefaction wave can act as a focusing lens that deflects light rays to the axis of the beam is validated by solving a self-consistent problem. Non-steady state acoustic equations of gas dynamics that allow for laser radiation absorption, as well as the equations describing the propagation of the radiation in an inhomogeneous medium, are solved. The occurrence of focusing depends strongly upon the form of the laser beam. No axial focusing occurs when radiation with Gaussian intensity distribution propagates through a gas medium; a "hot ring" is formed, which moves toward the radiator and away from the axis of the beam with time. It is found that wave movements of the medium induced by absorption of radiation results in self-focusing of laser beams. References 7: 5 Russian, 2 Western.

[331-6900]

UDC: 535.42+621.373.535

DIFFRACTION LOSSES IN RESONATOR WITH DIAPHRAGM WITH VARIABLE TRANSMISSION COEFFICIENT

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 7 Dec 83) pp 1105-1107

BOYTSOV, V.F. and VLADIMIROV, A.G.

[Abstract] The influence of the coefficient of reflection of a diaphragm that varies across the aperture on diffraction losses of lower transverse modes and the associated frequency difference of the counter-propagating waves that are generated is investigated. An annular resonator consisting of two flat mirrors and one cylindrical mirror with a diaphragm having a variable transmission coefficient is analyzed. The resonator mode losses were determined by solving numerically an integral equation derived elsewhere. The numerical results obtained for lower transverse mode losses are studied as a function of the finite order of the matrices employed. References 5: 3 Russian, 2 Western.

[236-6900]

UDC: 535.2+535.39

TRANSFORMATION OF OPTICAL BEAM INCIDENT ON NONPLANAR INTERFACE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 1 Dec 82) pp 1070-1073

BEKSHAYEV, A. Ya.

[Abstract] The oblique incidence of an optical beam on the interface between dielectric media is examined in paraxial approximation in order to study the transformation of the distribution of the complex amplitude and phase changes. Formulas are derived that can be used to find the transformation of an arbitrary beam on an arbitrary interface. The transformation of a Gaussian beam of general type on a spherical interface is analyzed as an example, demonstrating agreement with existing findings. The formulas derived are helpful in that they automatically make allowance for small arbitrary disruptions in the relative orientation of the incident beam and the boundary in a standard coordinate system, and do not require that the axes be rotated and complex computations performed each time. References 10: 9 Russian, 1 Western.

[236-6900]

UDC: 535.317.1

OPTICAL IMAGE OF BOUNDED OBJECTS. II

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 18 Feb 83) pp 1074-1078

VOROB'EV, Yu.V. and DVORETSKIYA, I.N.

[Abstract] An eigenfunction expansion apparatus developed previously by one of the authors for assessing image quality objectively and for recovering images distorted by aberrations in the optical system and by diffraction is extended to functions in which the response function is axisymmetrical. Isolated bounded objects with known dimensions comparable with the resolvable distance of the optical system are studied. The use of the image recovery procedure, which is based on the least-squares method, is demonstrated by the example of an image distorted by light diffraction on a diaphragm. The influence of noise on image recovery is examined. References 2 Russian.  
[236-6900]

UDC: 535.853-1

RESOLUTION OF NONLINEAR RESONANT IR SPECTROMETER

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 20 Jan 83) pp 1070-1082

KRASNIKOV, V.V., PSHENICHNIKOV, M.S. and SOLOMATIN, V.S.

[Abstract] The influence of two-photon absorption of the signal and generated waves on the spectral and energy characteristics of the converter is investigated. The conversion efficiency and resolution of an IR spectrometer based on the dispersion of the nonlinear susceptibility are analyzed. An experimental setup incorporating an Nd-YAG Q-modulated laser is described. It is found that good conversion efficiency can be achieved, but at the cost of degraded resolution because of the influence of two-photon absorption of the signal and generated waves in the pumping fields. References 3: 2 Russian, 1 Western.  
[236-6900]

UDC: 535.375.5.01

RAMAN SCATTERING OF LIGHT DURING COHERENT EXCITATION OF THREE-LEVEL SYSTEMS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 15 Feb 84) pp 961-962

BASHAROV, A.M.

[Abstract] This study investigates the influence on a medium of two light pulses with duration  $\tau_1$  and  $\tau_2$  separated by a time interval  $\tau$  with the first pulse in resonance with the optically permitted transition  $E_a \rightarrow E_b$ , and the second in resonance with the adjacent optically permitted transition  $E_c \rightarrow E_b$ . Expressions are derived for the intensity of the anti-Stokes and Stokes signals assuming that the pulse durations are much shorter than the irreversible relaxation time and that the pulse areas are small. The nature of the polarization of the Raman scattering signal is found to depend strongly upon the type of two-quantum transition  $E_c \rightarrow E_a$ . The drop in the intensity of Raman scattering as  $\tau$  increases is described by different curves, depending upon the polarization of the excitation pulses, which can be used to determine the relaxation parameters of the two-quantum transition  $E_c \rightarrow E_a$ . The Raman scattering is found to represent a new echo-type phenomenon that is useful in nonlinear spectroscopy. References 5: 4 Russian, 1 Western.

[236-6900]

UDC: 535.2+537.533.3

METHOD FOR DETERMINING PARAMETERS OF RELATIVISTIC ELECTRON BEAMS FROM SCATTERED RADIATION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 57, No 6, Dec 84 (manuscript received 12 Apr 83) pp 997-1002

ZHURAVLEV, V.A., KARPOV, O.V., MIKHEYEV, V.V., MUZALEVSKIY, V.Ye. and PETROV, G.D.

[Abstract] Methods are proposed for quick estimation and exact measurement of the parameters of a strong-current relativistic electron beam from the spectrum of scattered laser radiation. An experimental setup is described in which the intensity of the scattered radiation is maximized and the spectrum is kept within the region of greatest sensitivity of the photodetectors. Examination of oscillographic recordings of the output indicates that the signal can be divided into three components: 1) the measured scattered radiation pulse; 2) the background caused by cathode plasma glow; and, 3) instrumentation noise. The theoretical values of the signals recorded in the spectral channel are found to differ from the experimental values by no more than  $1.5\sigma_0$  indicating that the method is sufficiently accurate. References 10: 8 Russian, 2 Western.

[236-6900]

UDC: 517.9:537874.6

METHOD FOR NUMERICAL SOLUTION OF PROBLEMS OF ELECTROMAGNETIC WAVE DIFFRACTION  
ON SURFACES WITH ANISOTROPIC CONDUCTIVITY

Moscow DOKLADY AKADEMII NAUK SSSR Vol 280, No 2, Jan 85 in Russian  
(manuscript received 22 Mar 84) pp 333-337

DAVYDOV, A.G., ZAKHAROV, Ye.V. and PIMENOV, Yu.V., Moscow State University  
imeni M.V. Lomonosov, Moscow Electrotechnical Communications Institute.

[Abstract] A general method is developed for the numerical analysis of problems of electromagnetic wave diffraction for the class of anisotropic objects consisting of smooth surfaces with arbitrary configuration with anisotropic conductivity such that there is a direction at each point on the surface for which the surface exhibits ideal conductivity, and is non-conducting in all other directions. Diffraction on an anisotropically conducting segment of a paraboloid of revolution is investigated as an example. The method can be extended directly to the case of a system of piecewise-smooth surfaces that may be in contact with one another. References 1 Russian.

[226-6900]

UDC: 538.561

EXPERIMENTAL OBSERVATION OF DIFFRACTION RADIATION EFFECT IN MILLIMETER BAND

Moscow DOKLADY AKADEMII NAUK SSSR Vol 280, No 2, Jan 85 in Russian (manuscript received 20 Feb 84) pp 343-347

VERTIY, A.A.; TSVYK, A.I. and SHESTOPALOV, V.P., Academician, Ukrainian SSR Academy of Sciences, Institute of Radio Physics and Electronics, Ukrainian SSR Academy of Sciences.

[Abstract] The characteristics of pure millimeter-band diffraction radiation excited by a modulated electron beam passing near a diffraction grating are investigated experimentally. An experimental diffraction radiation analyzer employing a miniature diffraction radiation generator to modulate the electron beam is described. New characteristics of diffraction radiation are observed that are associated with the influence of the focusing magnetic field and with the electron-wave processes occurring, specifically the excitation of space-charge waves and cyclotron waves with various kinds of resonant and oscillatory phenomena occurring in the beam. It is found possible to measure and analyze electron-wave processes occurring in electron beams by the characteristics of diffraction radiation. References 7: 6 Russian, 1 Western.

[226-6900]

UDC: 532.525.3+535.8

LASER DIAGNOSIS OF HYDRODYNAMICS AND DISPERSION STRUCTURE OF SPRAYING JET

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 47, No 6, Dec 84 (manuscript received 20 Sep 83) pp 936-940

BORODULYA, V.A., GREBEN'KOY, A.Zh., RUBEZHANSKIY, V.I. and RHODAN, I.V., Institute of Heat- and Mass-Exchange imeni A.V. Lykov, Belorussian SSR Academy of Sciences.

[Abstract] The dynamics characteristics and dispersion structure of the spray from a pneumatic spray nozzle, and the influence of an added third component on these characteristics, are investigated by the laser Doppler method and the laser 'knife' method. The laser 'knife' system incorporated an LG-38 laser radiation source, a telescope system and a cylindrical lens to form a flat beam. The central region of the spray produced by the laser 'knife' is found to consist of a nucleus of reverse flows surrounded by a carrier stream. The velocity of the stream is found to be distributed unevenly over the cross-section and to be bounded by an 'internal' layer surrounding the nucleus of reverse flows, and an 'outer' layer at the periphery of the jet spray. The experimental findings indicate that droplets are broken up both within and without the region of decay of the jet. References 11 Russian.

[224-6900]

UDC: 535.317

INFLUENCE OF DESIGN PARAMETERS OF PARABOLIC MIRROR SEGMENT ON IMAGE CHARACTERISTICS IN COHERENT OPTICAL PROCESSING SYSTEM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, Jul 84 (manuscript received 28 Aug 83) pp 26-27

DUDKINA, Ye.A.

[Abstract] The relationship between the design parameters of parabolic mirror segments and the characteristics of the processed image in a coherent optical processing system are investigated in order to assess the influence of individual factors (such as the wavelength of the radiation, the diameter the image being processed and the focal length of the parabolic mirror) on the image quality in the spectral plane. Formulas are derived for assessing this influence that can also be used to solve the inverse problem of finding the design parameters of the parabolic mirror and its accuracy requirements on the basis of the requirements for the image quality in the spectral plane and the characteristics of the processed image. References 3: 1 Russian, 2 Western. [135-6900]

REFRACTION OF LASER BEAMS IN SHOCK WAVE

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, Jul 84  
(manuscript received 28 Jul 82) pp 1-3

KRIKSUNOV, L.Z. and PLIYEV, A.Ye.

[Abstract] The transmission of laser beams through the meridional cross section of an optically perturbed region formed in a supersonic air stream ahead of an optically transparent hemispherical body is investigated. A method is developed for calculating the beam trajectories in which the angle of refraction of the beams in the shockwave front is determined, after which the beam trajectory in the heterogeneous region is calculated. The proposed approach can be employed in optical methods investigating supersonic flow about bodies, and for phase correction of laser beams by gas jets. References 2 Russian.  
[135-6900]

NEW PRINCIPLE FOR MICROWAVE FIELD LASER MEASUREMENTS IN PLASMA

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 10, No 23,  
12 Dec 84 (manuscript received 2 Jul 84) pp 1443-1446

GAVRILENKO, V.P. and OKS, Ye.A.

[Abstract] The interaction of an atom with two monochromatic oscillating fields, one of which - the laser field - is in resonance with the atomic transition, and the other of which is a low frequency field, is investigated. The influence of the low-frequency field on the propagation conditions for laser radiation in an atomary medium is investigated. The possibility of using a laser field to make spectroscopic measurements of the low frequency field in plasma and gas is considered. The influence of the laser fields and low frequency fields on a hydrogen atom are investigated for times much smaller than the atomic level relaxation time. The influence of the low frequency field on the absorption of laser radiation is analyzed.

References 5 Russian.

[235-6900]

## LASER RADIATION WAVEFRONT CONJUGATION IN FIBER OPTIC LIGHTGUIDES

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 10, No 23,  
12 Dec 84 (manuscript received 20 Aug 84 after revision) pp 1416-1420

CHERTKOV, A.A.

[Abstract] Wavefront conjugation precision during stimulated Brillouin scattering is investigated in a monofiber with spatially homogeneous and inhomogeneous beams at  $\lambda = 1.06 \mu\text{m}$ . A Q-modulated YAG:Nd<sup>3+</sup> laser with initial transmission of 25% was employed as the radiation source. The energy of the incident and reflected radiation was measured by means of F-28 photoelements outputting their signals to an S8-12 oscilloscope. The behavior of the coefficient of reflection from the stimulated Brillouin scattering mirror as a function of the amount by which the pumping energy exceeded the threshold was found to be the same for all types of fibers, and to be independent of astigmatism and angular beam divergence. The wavefront conjugation quality as a function of the energy level was also the same for all of the lightguides employed: quartz, silicate and silicate-quartz. The good wavefront conjugation observed for astigmatic and spatially inhomogeneous beams make it possible to compensate satisfactorily for inhomogeneities in the distorting wavefront of the beam. References 5: 4 Russian, 1 Western.  
[235-6900]

UDC: 528.71:551.511.6

## DETERMINATION OF TRANSFER FUNCTION OF ATMOSPHERIC MODULATION CONSIDERING SCATTERING AND TURBULENT PROPERTIES OF THE MEDIUM

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY RAZDEL GEODEZIYA I  
AEROFOTOSYEMKA in Russian No 4, July-Aug 85 (manuscript received 3 Jul 84)  
pp 81-89

OVECHKIN, V.N., Graduate Student, Moscow Order of Lenin Institute of Geodetic Engineering, Aerial Photographic Surveying and Cartography.

[Abstract] The distortion of signals forming a photographic image in the optical wavelength band as they pass through the atmosphere depends on the combined influence of a number of factors including the scattering properties of the atmosphere, atmospheric turbulence, aerodynamic turbulent mixing of air layers adjacent to the skin of the aircraft, etc. The purpose of this work is to develop and analyze algorithms for computation of the modulation transfer function of the atmosphere. The parameters of the atmosphere characterizing its turbulence are described using a structured, three-dimensional or time function rather than a correlation function. The transfer function is found to be determined primarily by the scattering properties of the medium. Turbulent optical properties of the atmosphere must be considered if photographic aerial surveys are performed using cameras with a focal length over 500 mm. The influence of turbulent aerodynamic mixing of the air on the transfer function of the atmosphere must be considered if the platform is moving at over 450 km/hr. Figures 3, references 8: 7 Russian, 1 Western.  
[050-6508]

## OPTICAL-FIBER LINES IN OPEN-HEARTH FURNACE CONTROL SYSTEM

Moscow NTR: PROBLEMY I RESHENIYA, 19 Nov-2 Dec 85, No 13, pp 1, 2

VOLODIN, B.

[Excerpt] I witnessed an unusual sight recently at the computer-technology proving facility of the All-Union Central State Scientific Research Institute of Comprehensive Automation (TSNIIKA). Imagine a microcomputer which gives information readout on an indicator panel. Between the computer and this panel are two other objects, which are connected by a fine cable a few millimeters in diameter.

I was present at laboratory tests in which the effects of a changing electromagnetic field on an optical-fiber communications line were being simulated. To be more precise, effects of electrical interference on a device for the transmission of discrete information through an optical fiber were being studied here.

A computerized system for controlling the open-hearth melting process (certificate of invention No. 916548) has been in operation for a year at the Cherepovets Metallurgical Complex. A computer processes information from sensors and reads it out, together with a prediction of the final condition of the steel, on a panel work station. The system's 'brain' is not limited to forecasting, however; it calculates optimal control measures and issues recommendations on the terminal of the control console at the operator's station.

Optical-fiber technology is not a new development. But it has not been used in our metallurgical industry up until now, and the TSNIIKA scientists' experience is therefore original in its way. The main components of their control complex are a receiver and a transmitter, which are connected by a fiber cable. This cable possesses such advantages as complete noise immunity and, incidentally, spark and fire safety.

I asked Candidate of Technical Sciences S. Yu. Myl'nikov, head of the laboratory, to tell about the features and prospects of this new technology.

"A Moscow plant recently began to produce sets of equipment for optical-cable communications that we are using in our laboratory. This equipment transmits

information at the rate of a megabyte per second. This is quite sufficient for our purposes. The sets are designed for operation with microcomputers of the 'Elektronika-60' or "Elektronika-100" type, or with others similar to them. The series production and broad industrial use of such systems became necessary long ago. They are very promising; they are safe, reliable, fairly simple and have large throughputs. We plan to use optical-fiber technology a great deal in the development of specific automated process control systems."

The only thing left to add is that this new technology was installed recently at the Cherepovets Metallurgical Complex. Industrial testing of it has now begun.

FTD/SNAP  
/9716  
CSO: 1862/81

UDC: 535.416.3

COMPENSATION OF NONLINEAR DISTORTIONS OF LIGHT BEAMS IN MOVING MEDIUM

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY. FIZIKA in Russian No 2, Feb 85  
(manuscript received 16 Apr 84 after revision) pp 13-19

KOZHEVNIKOVA, I.N., SUKHORUKOV, A.P. and TROFIMOV, V.A., Moscow State University imeni M. V. Lomonosov.

[Abstract] The speed and stability of adaptive control of the inclination and focusing of a beam passing through a layer of a nonlinear medium are examined in an aberration-free approximation. Adaptive system performance is analyzed with respect to peak intensity, the position of the center of gravity of the beam, and the power received in the aperture. Compensation of nonlinear distortions by flexible mirrors with constraints is examined. Differential equations for controlling the inclination of the wavefront are described. References 10: 8 Russian, 2 Western.  
[341-6900]

PLASMA PHYSICS

MAGNETIC REARRANGEMENT AND CHANGE IN PLASMA CONCENTRATION DURING DISRUPTION OF CURRENT LAYER

Moscow AKADEMIYA NAUK SSSR INSTITUT OBSHCHEY FIZIKI, Preprint No 179, 1984  
(signed to press 26 Jun 84)

BOGDANOV, S.Yu., DREYDEN, G.V., KOMISSAROVA, I.I., MARKOV, V.S., OSTROVSKAYA, G.V., OSTROVSKIY, Yu.I., FILIPPOV, V.N., FRANK, A.G., KHODZHAYEV, A.Z. and SHEDOVA, Ye.N., Institute of General Physics, USSR Academy of Sciences.

[Abstract] The rapid breakdown of a plane current layer is investigated experimentally. Measurements of the magnetic field in the vicinity of the current layer, and of the electron concentration therein, are used to find the structure of the magnetic field, the spatial distributions of the current density, the current velocity and the average transverse particle energy in the layer, as well as their behavior over time. The magnetic field structure and current distribution within the layer are analyzed. Changes in the electron concentrations during successive stages of evolution of the current layer are explained. It is found that the abrupt breakdown of the current layer is a complex process, during which numerous characteristics change abruptly: the structure of the magnetic field and the geometry of the layer, the conductivity of the plasma, the current velocity and the characteristic energy of the particles. The process occurs in two stages, the first of which is characterized by a comparatively slow reduction in the current density and plasma concentration in the layer; in the second stage, the rates at which the current density and electron concentration drop increases rapidly, the layer becomes thicker, the current velocity and characteristic energy of the particles increase, and the conductivity of the plasma drops off by approximately an order of magnitude. Small-scale turbulence appears to occur in the second stage, which reduces the conductivity of the plasma sharply. References 10: 8 Russian, 2 Western.

[323-6900]

THE NEED TO ACCOUNT FOR THE SELF-CONSISTENT AVERAGE ELECTRICAL FIELD IN THE QUASI-LINEAR THEORY OF PLASMA

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 11, No 4,  
26 Feb 85 (manuscript received 19 Oct 84) pp 220-224

VEDENIN, P.V., KARBUSHEV, N.I. and RUKHLIN, V.G.

[Abstract] The beam-plasma interaction as an electron beam passes through a plasma is investigated analytically within the framework of a two-dimensional model for the initial weakly-nonlinear stage, in which the methods of the quasi-linear theory are valid. It is found that the nonlinear average self-consistent electrical field always hinders any change in the total current in the system, reducing the current amplification effect during beam instability, and lessening beam braking during Buneman instability. The role of the average field is examined using the examples of the excitation of resonant beam and Buneman instabilities by a monoenergetic electron beam. References 5: 3 Russian, 2 Western.

[247-6900]

UDC: 533.082.5

JET FORMATION DURING PLASMA COMPRESSION IN ACUTE-ANGLED GEOMETRY

Novosibirsk ZHURNAL PRIKLAKNOY MEKHANIKI I TEKHNICHESKOY FIZIKI in Russian  
No 5, Sep-Oct 84 (manuscript received 4 Jul 83) pp 68-73

TERNOVOY, V.Ya.

[Abstract] This study investigates the flow modes occurring during the formation of a dense high temperature plasma by shock compression of gas in an acute-angled geometry employing a metal compression device. The flow modes are analyzed as a function of the velocity of the compressing device, the half-aperture angle of the cone and the material of which the compression device and wall are made. Analytical expressions are derived for the critical angle of rotation of the supersonic flow. Asymptotic solutions are found for the critical angle of rotation of flow and the angle of rotation of the interface boundary as the velocity of the compression device increases. The importance of accounting for jet formation in designing devices for plasma compression employing acute-angled geometry is demonstrated. References 14:

11 Russian, 3 Western.

[184-6900]

UDC: 533.9

HIGH FREQUENCY OSCILLATION SPECTRUM OF MAGNETOACTIVE PLASMA IN FIELD OF ELECTROMAGNETIC PUMPING WAVE

Alma-Ata IZVESTIYA AKADEMII NAUK KAZAKHSKOY SSR: SERIYA FIZIKO-MATEMATICHESKAYA in Russian No 6 , Nov-Dec 84 (manuscript received 15 Dec 83) pp 70-71

ARKHIPOV, Yu.V. and BAIMBETOV, F.B., Kazakh State University imeni S.M. Kirov.

[Abstract] An expression is derived for the spectrum of oblique Langmuir waves in a magnetoactive plasma for an arbitrary pumping wave field amplitude that is more general than the existing expression for similar waves in a plasma containing magnetized electrons. The expression can be used to solve the problem of the generation of harmonics of electromagnetic radiation in a plasma in order to diagnose parametric turbulence.

[225-6900]

UDC: 533.95:537.84

SEPARATION OF PLASMA CLOUD IN HOMOGENEOUS MAGNETIC FIELD

Riga MAGNITNAYA GIDRODINAMIKA in Russian No 4, Oct-Dec 84 (manuscript received 2 Jan 84) pp 81-87

GORBACHEV, L.P.

[Abstract] This study investigates the terminal stages of the separation of plasma clouds, when the conductivity is low and the velocity of the cloud drops off significantly and the resulting dissipative processes become significant. An ionized gas expanding symmetrically and spherically in a vacuum in the presence of a homogeneous external magnetic field is analyzed. The electrical conductivity of the plasma as the gas is cooled is analyzed. The form of the boundary of the expanding plasma, and the change in plasma density over time, are investigated. The characteristics of the electromagnetic pulse generated by the expanded plasma are studied. The analytical methods derived for studying the terminal stage of plasma cloud expansion in a magnetic field make it easier to find numerical solutions for any temporal behavior of the conductivity of the plasma. References 8 Russian.

[222-6900]

UDC 533.95

NUMERICAL MODELING OF UNIDIMENSIONAL QUASILINEAR RELAXATION OF RELATIVISTIC ELECTRON BEAM IN INHOMOGENEOUS PLASMA WITH COLLISIONS

Leningrad ZHURNAL TEKHNICHESKII FIZIKI in Russian, Vol 55, No 1, Jan 85  
(manuscript received 30 May 84 after revision) pp 215-217

GUREYEV, K.G., NIKULIN, M.G. and SIONOV, A.B.

[Abstract] A numerical solution is found to the problem of unidimensional quasilinear relativistic electron beam relaxation in an inhomogeneous plasma with collisions, making it possible to track the dynamics of the process and to establish the system parameter values for which the electron collisions and longitudinal inhomogeneity of the plasma density retard the beam relaxation significantly, thus increasing the transport length. The results of a calculation for an initial angular dispersion of the beam particles of 0.1 and thermal noise with spectral energy density of  $10^{-4}$  are presented. Figures 3, references 5: 4 Russian, 1 Western.

[261-6900]

TECHNICAL PHYSICS

PLASMA BEAM DISCHARGE IN ABSENCE OF MAGNETIC FIELD WITH COUNTER-PROPAGATING ELECTRON BEAMS

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 10, No 22, 26 Nov 84 (manuscript received 22 Feb 84 after revision) pp 1398-1401

GROZDETSKIY, V.S., KOVALENKO, V.P. and PARNETA, I.M., Electric Welding Institute imeni Ye.O. Paton, Ukrainian SSR Academy of Sciences.

[Abstract] The characteristics of plasma beam discharge are investigated for the case of beams moving in opposite directions. The experimental setup employed a cylindrical copper plasma chamber 20 cm in diameter with 10-cm slits cut along its generator. Diverging electron beams produced by directly-heated tungsten filaments were injected into the chamber through these slits. The parameters of the plasma were measured on the axis of the system along the electron portion of the characteristic of a cylindrical Langmuir probe. The experiments indicated that two different interaction modes between counter-propagating beams in a plasma beam discharge can be distinguished, depending upon the beam current, the cathode potential and the gas pressure. In the first of these, no discharge occurs for a single beam; however, a visually observable discharge does occur for two beams moving in opposite directions. In the other mode, the current of one beam exceeds the discharge ignition threshold. The lower threshold current of the counter-propagating beams as compared for a single beam in the first of these modes is associated with increased feedback in the system. References 6: 4 Russian, 2 Western.

[174-6900]

UDC 568.561

SYNCHROTRON RADIATION OF MINIATURE ACCELERATORS WITH STRONG MAGNETIC FIELD

Leningrad ZHURNAL TEKHNICHESKIY FIZIKI in Russian Vol 55, No 1, Jan 85 (manuscript received 28 Feb 84) pp 212-214

ANEVSKIY, S.I., All-Union Scientific Research Institute for Optical-Physical Measurement

[Abstract] The characteristics of the synchrotron radiation of miniature synchrotrons and accumulators are investigated. The intensity of the

synchrotron radiation of a miniature accelerator is estimated by a formula that relates the spectral flux density of the synchrotron radiation at the working wavelength with the relativistic electron energy and orbital radius. The efficiency of synchrotron radiation sources is compared for a number of spectral regions. In addition to providing high spectral intensity, miniature synchrotron radiation sources are relatively inexpensive to build and operate. The radiation-safe operating mode of miniature accelerators makes it possible to omit special protective means for operating personnel. Figures 2, references 5: 4 Russian, 1 Western.  
[261-6900]

UDC: 533.9.082.5

TEMPERATURE MEASUREMENTS IN AIR PLASMA JET IN INDUCTION PLASMOTRON AT REDUCED PRESSURES

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 1, Jan 85 (manuscript received 28 Jun 83) pp 108-114

GEORG, E.B. and YAKUSHIN, M.I., Institute of Problems of Mechanics, USSR Academy of Sciences.

[Abstract] This study describes temperature measurements made in a subsonic air jet at pressures of  $5 \cdot 10^3 - 10^5$  Pa. The first negative system  $N_2^+$  was examined. The distribution of the relative line radiation intensities in the rotational ion structure of a nitrogen molecule  $N_2^+$  were found, using the results to determine the gas temperature. The relationship between the temperature of the jet and the pressure, as well as the temperature distribution along the axis of the discharge, were then found. The excitation temperatures for the  $N_2^+$  rotational levels, CN vibrational levels and oxygen atom levels are found to agree well and to correspond to the gas temperature. The method for measuring gas temperature is found to be applicable to the nucleus of a jet, which is confirmed by measuring the excitation temperature of the atomic levels of oxygen emitted from the nucleus of the jet.

References 11: 9 Russian, 2 Western.

[251-6900]

THERMODYNAMICS

UDC: 537.76:536.44

FEATURES OF THE USE OF THERMODYNAMIC DIFFERENTIAL EQUATIONS AT CRITICAL POINT OF PURE SUBSTANCES

Moscow TEPLOFIZIKA VYSOKIKH TEMPERATUR in Russian Vol 22, No 6, Nov-Dec 84  
(manuscript received 9 Sep 83) pp 1088-96

SYCHEV, V.V., RABINOVICH, V.A. and SHELUDYAK, Yu.Ye., All-Union Scientific Research Institute of Metrological Service.

[Abstract] Thermodynamic equations are examined, taking into account the fact that power laws define the asymptotic behavior of all thermodynamic quantities; asymptotic relationships are obtained for basic thermodynamic functions on different paths to the critical point. The relationships between critical exponents and critical amplitudes of fundamental thermodynamic quantities are examined. Scaling-theory relationships between the critical exponents are found to be the form for ordinary equations of thermodynamics at the critical point. Expressions are derived for certain combinations of properties or substances that have universal values independent of the type of substance and method used to describe the thermodynamic surface. These universal combinations can be used in working out date equations for the critical region to judge their accuracy and adherence to limiting conditions. References 10: 6 Russian, 4 Western.  
[207-6900]

UDC 536.63:546.65

DETERMINING DEBYE TEMPERATURE  $\Theta_0$  AND ANHARMONIC COMPONENT OF THE SPECIFIC HEAT CAPACITY OF SCANDIUM, YTTRIUM, AND LANTHANUM

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 3, Mar 85  
(manuscript received 30 Jan 84) pp 424-427

TOMILO, Zh.M. and PRYTKOVA, N.A., Institute of Solid State and Semiconductor Physics, Belorussian SSR Academy of Sciences

[Abstract] The specific heat capacity of scandium, yttrium and lanthanum were studied over the 4-300K temperature range. Double-distilled specimens

were investigated under adiabatic conditions by the absolute method using pulse heating of the specimen, to within 4% at the lowest temperatures, and 1% at the highest. The Debye temperature  $\theta_{\infty}$  and the anharmonic contribution to the specific heat capacity were determined by analyzing the experimental heat capacity data for temperatures at which the harmonic component exceeds  $0.5^{\circ}\text{R}$ . In contrast to the Debye temperature  $\theta_0$ , which is found in the region of the temperature of liquid helium and is a characteristic of the lowest energy modes.  $\theta_{\infty}$  is a characteristic of all phonon modes, and characterizes the center frequency of the entire phonon spectrum. References 12: 9 Russian, 3 Western.  
[355-6900]

UDC 536.2.01

DESIGN OF MEASUREMENTS FOR SOLVING INVERSE COEFFICIENTS PROBLEMS OF  
HEAT CONDUCTIVITY

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 48, No 3, Mar 85  
(manuscript received 21 Oct 83) pp 490-495

ARTYUKHIN, Ye.A., Moscow Aviation Institute imeni, S. Ordzhonikidze

[Abstract] A numerical method is proposed for finding the optimum location for a fixed number of temperature probes in solving coefficient inverse problems of heat conductivity. An interactive identification procedure is devised in which the boundary-value problems are solved numerically using a monotonic approximation scheme, and the system of difference equations is solved by the difference factorization method. Iteration by coefficients is employed in the nonlinear case. The results indicate that there is a fairly small region within which the temperature sensor must be placed, and that the area becomes smaller as the number of sectors increases. The possibility of constructing locally-optimal measurement designs suggests that the experimental design process and the identification of characteristics are iterative procedures. References 13: 11 Russian, 1 Western.  
[355-6900]

UDC 517.9:621.378.325

CERTAIN PROPERTIES OF MATHEMATICAL MODEL OF LASER HEATING OF METALS IN AIR

Moscow DOKLADY AKADEMII NAUK SSSR, Vol 281, No 1, Mar 85 (manuscript received 12 July 84) pp 55-59

AKHROMYEEVA, T.S., USSR Academy of Sciences Corresponding member BUNKIN, F.V., KIRICHYENKO, N.A., KURDYUMOV, S.P., MALINYETSKIY, G.G., and academician SAMARSKIY, A.A., Institute of General Physics, USSR Academy of Sciences, Institute of Applied Mathematics, imeni M.V. Keldysh, USSR Academy of Sciences

[Abstract] This study examines the properties of a synergetic model of the processes occurring in open dissipative systems as employed in laser thermochemistry. A boundary value problem representing the heating of a thin metal film in air by a laser beam is analyzed. The variation in temperature and oxide thickness at different points in the specimen over time is analyzed. It is found that complex autonomous wave processes can exist even in the simplest model of laser thermochemistry. References: 13 Russian.  
[331-6900]

THEORETICAL PHYSICS

UDC 519.7:517.984.5

POTENTIAL FUNCTION METHOD IN PATTERN RECOGNITION AND INTEGRAL OPERATORS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A. FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 3, Mar 85 (manuscript received 11 Aug 83) pp 63-65

KOTLYAR, B.D., All-Union Scientific Research Institute for the Mechanization of Labor in Ferrous Metallurgy

[Abstract] A new method is proposed for constructing linear separating functions and obtaining estimates of the number of corrections on the basis of the auxiliary integral Fredholm operator. It is found that the separating function should not be sought in the initial feature space, but rather in the diagnostic space that is constructed with the help of the integral Fredholm operator.  
[352-6900]

UDC 621.385.6; 621.372.413

PONTRYAGIN'S MAXIMUM PRINCIPLE IN OPTIMIZING DIFFRACTION ELECTRONIC INSTRUMENTS

Moscow DOKLADY AKADEMII NAUK SSSR, Vol 281, No 1 (manuscript received 18 July 84) pp 78-81

TARASOV, M.M., TRET'YAKOV, O.A., Ukrainian SSR Academy of Sciences academician SHESTOPALOV, V.P. and SHMAT'KO, A.A., Khar'kov State University imeni Gor'kiy

[Abstract] The system of equations derived previously by the authors to describe the physical processes occurring in resonant feedback oscillators with zero-type distributed interaction is extended to the case of arbitrary synchronization error. The possibility of exploiting Pontryagin's maximum principle in electronics is demonstrated by the example of finding the optimum parameters of an oscillator with maximum efficiency for a given output power level in an assigned frequency band for a particular electron gun. An oscillator with a Gaussian-distributed high frequency field envelope in an open cavity is optimized as an example. References: 7 Russian.  
[331-6900]

LOGIC AND GAME THEORY

UDC: 519.9

DIFFERENTIAL ESCAPE GAMES IN HILBERT SPACE

Tashkent PRIKLADNAYA MATEMATIKA I MEKHANIKA: SBORNIK NAUCHNYKH TRUDOV  
in Russian, 1983, pp 49-54

MUKHSINOV, Ye.M.

[Abstract] Sufficient conditions are derived from previous findings which extend to the infinite-dimensional case and which guarantee the possibility of escape in linear differential games described by differential equations in a Hilbert space. Three examples are presented. References 5: 4 Russian, 1 Western.  
[250-6900]

## NUMERICAL ANALYSIS AND ALGORITHMS

UDC 519.873

### TWO ALGORITHMS FOR ESTIMATING MONOTONIC FAILURE PROBABILITY

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A. FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 3, Mar 85 (manuscript received 24 Feb 84) pp 65-68

KUZNETSOV, N.Yu., Institute of Cybernetics, Ukrainian SSR Academy of Sciences

[Abstract] Two algorithms are presented for constructing unbiased estimates of the probability of monotonic failure of a high-reliability system. The algorithms can be used to find the system failure probability in a given time interval, and at a given instant. The use of the algorithms to estimate monotonic failure probability is shown by an example. References: 5 Russian. [352-6900]

UDC 519.27:681.3

### ESTIMATES OF NUMBER OF BOOLEAN COMPARISON OPERATIONS FOR ORDER STATISTICS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR. SERIYA A. FIZIKO-MATEMATICHESKIYE I TEKHNICHESKIYE NAUKI in Russian No 3, Mar 85 (manuscript received 18 Jan 84) pp 59-62

IVANOV, V.V. and KORZHOVA, V.N.

[Abstract] An algorithm is investigated for finding the k-smallest sample for which the average number of Boolean (bit by bit) comparison operations is found asymptotically with respect to N, ranging from N to  $\vartheta N$ , as a function of the distribution of the sample (where N is the sample size); the sample of numbers is assumed to be assigned as an array of nonnegative 0-bit binary integers. The first digit of the array of N numbers is compared, after which the entire array is then divided into two parts, one of which contains the numbers with zero as the high-order (first) bit, and the other with 1. The arrays are then arranged in order from 1 to N, with the array having a first digit of 1 being the lowest. The sought digit is that occurring in the kth place. After  $\rho$  steps, the k-smallest number will be in the kth place. References 7: 4 Russian, 3 Western. [352-6900]

UDC: 681.513.8

APPLICATION OF PRINCIPLES OF PATTERN RECOGNITION THEORY TO ANALYSIS OF  
PERIODIC PROCESSES

Kiev AVTOMATIKA in Russian No 1, Jan-Feb 85 (manuscript received 19 Jul 83)  
pp 3-7

ADASOVSKIY, B.I. and PINDYUK, P.P., Institute of Cybernetics imeni V.M. Glushkov,  
Ukrainian SSR Academy of Sciences.

[Abstract] This study investigates the use of pattern recognition to analyze periodic processes characterizing the differentiable state of objects. The processes investigated are viewed as characteristics that are functions of time and that express a change in various physical quantities. The proposed analytical method is based on the idea of calculating the informativeness of the instantaneous values of the periodic process with an assigned partitioning of the finite set of realizations of the process into equivalence classes. The mutual difference between the equivalence classes of the reaction of plants to the periodic stimulating effect of light and dark is computed as an example. References 5 Russian.

[343-6900]

UDC: 621.501.72

PREDICTION OF RANDOM TIME SERIES BY CORRELATION FEATURES

Kiev AVTOMATIKA in Russian No 1, Jan-Feb 85 (manuscript received 13 Oct 82)  
pp 7-12

GRISHKO, V.G. and STREL'CHENKO, V.A., Institute of Strength Problems,  
Ukrainian SSR Academy of Sciences.

[Abstract] An iterative prediction procedure is proposed in which the characteristic features of the responses of interest are isolated in order to identify those that are most highly correlated with the assigned characteristic. The class is identified to which the response process belongs--steady-state processes, unsteady processes, or white noise; the feature that is most highly correlated with the process in question is predicted in accordance with the prehistory in the form of a series of trajectories obtained assuming unchanged external perturbations. The proposed prediction apparatus has been used in developing software for an automated scientific research system for investigating the strength properties of construction members employing the acoustic emission effect. References 6 Russian.

[343-6900]

UDC 621.391

GENERALIZATION OF MATHEMATICAL MODELS OF SIGNALS

Minsk VESTSI AKADEMII NAVUK BSSR. SERYYA FIZIKA-TEKHNICHNYKH NAVUK in Russian, No 1, Jan-Mar 85 (manuscript received 19 Dec 83) pp 82-85

VOLKOVICH, P.F., Institute of Technical Cybernetics, Belorussian SSR Academy of Sciences

[Abstract] New generalized mathematical models of signals are introduced on the basis of the definition of the concept of signal class. The generalized mathematical model for a class of signals is represented as a model or algebraic system consisting of a non-null set of element (signals), a set of operations defined in the set of elements, and a set of relationships (predicates) assigned to the set of elements. The algebraic system is combined with the measured set of signals, a probabilistic space based on the elements of the algebraic structures, a fuzzy set of the type  $n$  ( $n=1, 2, 3, \dots$ ), a fuzzy set whose membership functions represent mappings onto an arbitrary array type structure. Another approach is to generalize the theory of models to the case of an arbitrary truth space. References 9: 5 Russian, 4 Western. [365-6900]

UDC 681.327.68:778.38

ANALYSIS OF INFORMATION CHARACTERISTICS OF 2D TYPE HOLOGRAPHIC MEMORY

Minsk VESTSI AKADEMII NAVUK BSSR. SERYYA FIZIKA-TEKHNICHNYKH NAVUK in Russian No 1, Jan-Mar 85 (manuscript received 16 Oct 83) pp 85-92

YEROKHOVYETS, V.K., Institute of Technical Cybernetics, Belorussian SSR Academy of Sciences

[Abstract] The information characteristics of holographic storage employing two-dimensional recording on the physical medium is analyzed. The possibility of mathematical analysis and modeling of certain relationships for analyzing holographic storage for text and graphic documents is investigated from the viewpoint of general mathematical descriptions. Optimization of the structure of the object channel is analyzed. The highest spatial frequency transmitted by a microhologram is estimated. Graphic and analytical techniques for calculating and selecting technological document storage parameters are proposed that allow for optimum coordination of the data characteristics of all the components. References: 9 Russian. [364-6900]

UDC: 528.021.6

RECURRENT ESTIMATION OF RESULTS OF MEASUREMENT BY RADIO-GEODETIC SYSTEMS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY RAZDEL GEODEZIYA I  
AEROFOTOSYEMKA in Russian No 4, July-Aug 85 (manuscript received 2 Apr 84)  
pp 34-38

ZEMLYAKOV, I.M., Engineer, 'Soyuzmorinzhgeologiya'

[Abstract] A study is made of conditions of applicability of one version of the Kalman-Busey filter for measurements of radiogeodetic systems utilizing minimal *a priori* information. It does not require that the arrangement of the radiogeodetic system be known during computations, does not require solution of geodetic problems and is consequently speed-optimal and convenient for implementation in hardware. It functions by looking upon the ship carrying the equipment as a heavy material point moving in a flat inertial coordinate system. The filter suggested produces independent estimates of the coordinates of the radiogeodetic system. It requires no other sensors, data on the arrangement of the system or solution of geodetic problems.

References 4 Russian.

[050-6508]

PROBABILITY AND STATISTICS

UDC: 519.216

DEGREE OF DYNAMIC CORRELATION AND THE PROBLEM OF DETERMINING THE DYNAMIC NATURE  
OF RANDOM PROCESSES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 29, No 12, Dec 84  
pp 2358-2364

KRAVTSOV, Yu.A. and ETKIN, V.S.

[Abstract] The property of partial predictability of processes generated by autostochastic systems is analyzed. The generally accepted characteristic of predictability--the mean square difference between the observed and predicted processes--is employed in conjunction with a new statistical characteristic--the degree of dynamic correlation, which is characterized by the degree of statistical connection between the prediction and observation. It is shown that autostochastic systems admit prediction over a finite amount of time called the dynamic memory time. The latter is a new characteristic time of the strange attractor which is determined by instrumentation noise and random internal signals and which determines the interval of determinate (predictable) behavior of the system and can be used to discover the dynamic nature of random processes. The error in predicting autostochastic systems subjected to random forces, and the error for systems with exponential trajectory divergence are estimated. The use of the degree of dynamic correlation to discover the structure of dynamic systems is analyzed. References 7:  
5 Russian, 2 Western.

[179-6900]

CONTROL THEORY

UDC: 517.97+519.2

THE CONCEPT OF CONTROLLABILITY FOR PARTIALLY OBSERVED STOCHASTIC SYSTEMS. II

Baku IZVESTIYA AKADEMII NAUK AZERBAYDZHANSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH I MATEMATICHESKIKH NAUK in Russian Vol 5, No 2, Apr-Jun 84 (31 Jan 83) pp 99-103

BASHIROV, A.E. and GADZHIYEV, R.R., Institute of Cybernetics.

[Abstract] This study derives a sufficient condition for S-controllability of partially observed stochastic systems, where S-controllability is the 'purely' stochastic part of the G-controllability, which indicates for partially observed stochastic systems the possibility of striking, with probability of at least  $p$ , the  $\sqrt{\epsilon}$ -vicinity of an arbitrary point belonging to a certain set that is everywhere dense in the state space. A sufficient condition for S-controllability of linear systems is also proved. References 2 Western. [176-6900]

UDC 62-50

A METHOD FOR SYNTHESIZING BINARY CONTROL OF NON-STEADY STATE NONLINEAR DYNAMIC SYSTEMS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 281, No 3, May 85 (manuscript received 3 July 83) pp 543-547

Academician YEMYEL'YANOV, S.V., BUROVOY, I.A., KIRILYCHYEV, V.N., All-Union Scientific Research Institute for Systems Research, Moscow Steel and Alloy Institute

[Abstract] Binary control is synthesized for a non-steady state nonlinear dynamic object which ensures that the system as a whole is dynamically stable and keeps the affix close to the desired trajectory in the presence of coordinate, parametric, and structural perturbations. The binary control is synthesized by using a nonnegative functional, whose type is selected depending upon the comparison system. Binary control is also synthesized for a bilinear nonstationary object to maintain the stability of the control system and the desired nature of the transitional processes. References: 3 Russian. [349-6900]